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A Method of Socializing High School Science

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I HAVE tried to socialize my science teaching by the use of groups as "clubs, artists and authors." As the method in its application is, I believe, a new one, I may be permitted to expose it in much the same way as I introduced it in class.

"We noticed that our books were called 'General Science,' and the first thing that came to our minds was the question, 'Why study Science?' "

"I have a plan that you will find so interesting. Let us divide into groups or clubs and find out. Each club will make a poster. How many would like to try this?" (Hands raised.)

"Then let us pick some leaders and form our groups. Who will make good leaders?"

(Each secretary chooses the chairman of his or her club. Places these.)

"You may pick out your members."

"Theodosia, your choice?"

Ans. "I don't care."

"Who would like to work with her?"

(Some raise hands. She picks out her members from these.)

"Hope, you may pick your members."

(She names them.)

"Phyllis."

Ans. "I'll take the rest."

"Boys, who among you would like to work together?"

(Four boys raise hands.)

"All right, you boys may work together."

"Who would you like as a leader, John?"

Ans. "Bill Littlewood."

"George?"

Ans. "I'll take Sam Epstein."

Constantiso—"I want him."

Dyer—"I'll take him."

Constantino—"I'll toss up with you."

Dyer—"All right."

(Flips coin.)

Dyer—"I win; I'll take Sam." (And names all.)

"The rest of you may go with Kenefick."

"Now that you have your clubs I want you to select a chairman, a secretary, and a name for your club."

"Will you please be prepared with the name of your club, your chairman and secretary, and some plan for your posters. I'll give you fifteen minutes for this."

(Interim, 15 minutes. Buzzing from each corner.)

"Time up."

"Marie, will you tell us about your club?"

Ans. "We are the Tickers and are writing about time."

"Ruth, what's your club?"

Ans. "We are the life-savers and our book is on health."

"Leonard, will you tell us about your club?"

Ans. "The Four Beavers is our club and house building is our book."

"Philip, what is your club?"

Ans. "The Radio Bugs and you know the rest."

"Since two meetings were necessary to complete the posters, and the second one was, in most cases, held at the home of some member, we will have a summary given."

"Theodosia, will you tell us about your club?"

"We are known as the 'Lightning Bugs'; held our first meeting in the Everett High School. We decided that before the next meeting we would all try and think of something good for the poster. Helen Dunlea volunteered to get the cardboard.

"The next meeting was held at my home; the suggestion of the steps of light from the bowl of fat to electricity was presented. We all agreed upon this, but thought it best to leave out the bowl of fat, having the torch, candle, lamp, gas and electricity. We all tried our spell at printing and Ruth's looked the best. All except Ruth and Helen said they knew they couldn't draw; Ruth agreed to test her artistic ability.

After a fairly good start was made, we were dismayed to see our torch looked like an ice cream cone and the lamp was too big in proportion with the rest of the drawing.

"We had tried to the best of our ability, but it was of no use. Finally, however, Ruth's sister came to the rescue and made the torch look like a torch and the lamp in good proportion. After it was painted we felt very well satisfied with our efforts. *Chairman*—Theodosia Clapp."

Fig. 1. Club Groups: 1, The Five Scribes; 2, The Deep Sea Divers; 3, The Life-Savers; 4, The Tickers; 5, The Four Shoemakers; 6, The Four Beavers; 7, The Five Detectors.

"Hope, let us hear your report next."

"We are the Dryads. We decided to make two posters, one showing how man rose through science, and the other showing different methods of travel. Another poster was planned to show how science aids house building. We all cut out pictures that would be suitable, and it was a trick to paste the pictures on cardboard so it would not look lopsided. We all worked happily together."

"Solomon, your summary, please."

"The two meetings of the 'Oil Kings' were held at the home of Bartholomew. We wanted to have a good poster. After a long and heated discussion, we decided to use oil as our topic. Our choice was oil because the Beacon Oil Company, one of the largest in the country, is in our city, and so we wanted to know something about it."

"Thomas, will you give yours now?"

"We the 'Five Detectors,' discovered that none of us could draw well; so the happy thought came to us to go to the Novelty Sign Painter and have him do it for us. When we arrived there, he was out, so we left a note telling him to phone Ralph, who would tell him what to do. Ralph told him about the poster which had been decided upon at our last meeting. He consented to do this. We thought it much better to have him do it than for us to have done it ourselves."

Teacher. "If you are all satisfied with your groups, please raise your hands. Well, then, no changes need to be made."

"Will each group please take the same places which they have had before?"

"We are all going to be authors, and each group is going to write a book. It isn't going to be a hard task, and I am sure that you will all find it interesting. I will give you ten minutes in which to discuss your individual books. You should decide upon the subject for your book and also the name of your club."

"Time up."

"Are there any questions you would like to ask about the books?"

1. *Mary.* "May we write to firms and attend exhibitions?"

Ans. "Write to anybody who will aid you and attend all the exhibitions you want."

2. *Parker.* "Can the books be typewritten?"

Ans. No, it would be much better to write them by hand."

3. *Philip.* "May we have pictures on the covers of our books?"

Ans. "You may design, draw, or put pictures on the cover."

4. *Lena.* "May we each write a chapter?"

Ans. "As many chapters as you wish."

5. *Gladys.* "Must the book be a definite number of pages?"

Ans. "Any number you would care to have, providing it makes a fairly good-sized book."

6. *Sarah.* "Do the books have to pertain to the same subject as the posters?"

Ans. "No; write on any subject you are interested in."

7. *Catherine.* "May we get outside help?"

Ans. "Your brothers, sisters, aunts or uncles—anyone can help you."

"Since three weeks out-of-school time and ten or fifteen minutes out of regular class work were spent on the making of the books, we shall not be able to tell you all that was done in the progress of them, because of lack of time, but we shall have summaries given to illustrate our methods. Of course, we continued our regular experiments in class.

"In the meanwhile you 'Five Detectors' can be putting up your radio set.

"Mildred, will you please give your summary?"

Summary of First Six Meetings of the "Tickers."

"The first meeting was held at Frieda's, where the chairman and secretary were elected. They were Phyllis and Mildred, respectively. We thought of numerous subjects upon which to write our book, and they were as follows: Cotton, Agriculture, Weaving, Photography, Electricity, and Navigation; but we decided that it would be impossible to reach a point; so it was agreed to leave the name until the second meeting, which was called in Room 304. It was then we thought of the topic, 'Time.' We called ourselves the 'Five Tickers.' As Phyllis is the best penman she condescended to write our book, with Marie writing on the History of Time, Water-clocks and Hourglasses; Lena writing on Measurements and Escapements; Frieda on Electric Clocks, and Myl on Chime Clocks. We then decided to have an oblong wrist watch. Our sixth meeting was held at Billie's, and we spent the greater part of the evening writing our index and designing the cover, as Freida had brought the preface. At every meeting we were served with ripping refreshments, usually consisting of sandwiches, ice cream, fancy crackers and tonic, or at least something that tasted real good to our hard-worked minds."

"Marie, can you tell us our preface on time?"

"From the days of ancient Egypt
Up 'till 1923,
Time and its study
Has affected you and me;
It is deeper as a study
Than the rest all put together,
For men may come and men may go—
But time goes on forever.

The old Egyptian wise men
Studied time the histories say,
Just like our modern scientists
Study it today;
On this deep and weighty subject
We have written our book,
And you can well imagine
All the time and pains it took.

In order that this little book
Be accurate and true,
We have taken scores of volumes
And read them through and through;
Then gathering all the knowledge
And the facts both large and small,
We have put them into language
Which is understood by all."

"Elgin Watch Company and Waltham Company sent us exhibits."

"George, we are ready to hear about your work."

"We have tried to write a small book on the inventions invented during the war of 1914-1917. We have written on the following subjects: Inventions from the army, navy, air service, and inventions of different gases. We wish to thank the War Department of Washington, the Navy Yard at Boston, and the East Boston Airport, for the kind assistance and valuable suggestions in preparing this book. I took the navy and had such a fine time making this small submarine that I gave up studying my other works."

"Ralph, you made an airplane, didn't you?"

"Sam, what have you obtained?"

Ans. "I have obtained these gas masks." (Explains.)

"Henry, what have you collected?"

Ans. "I have collected these helmets and guns from the war."

"Mabel, will you give us your summary?"

Summary of Meetings of the "Five Scribes."

"The 'Five Scribes' have held in all six meetings. These were held at the homes of various members of the club. In these meetings, together with a short social hour, we constructed our book as far as the first chapter.

"First, we decided that our topic should be, 'From Stilus to Corona.'

Second, that it should be dedicated to the goose who furnished the first quill pen.

"Third, that Lulu should write the entire book, thereby being relieved of composing a chapter.

"Fourth, that Mary should write an account of all the meetings.

"Fifth, that all should help in composing the following preface:

O you who read what Lulu penned,
And Hope and Mabel wrote
In company with Catherine
And Mary, kindly note,
That we've not tried to write a book
For folks to read in college,
Nor have we tried to increase the store
Of other people's knowledge.
We've merely tried to teach ourselves
And help out dear Miss Keyes;
So look with favor on our work
The "Five Scribes" ask you, "Please."

"Sixth, that the cover should be made of red cardboard in the shape of an ink-bottle.

"Our book consists of four chapters, one of which each girl is responsible for.

"We all sent letters to various firms, asking for samples and information concerning our topics.

"Every firm to which letters were sent answered in a very acceptable way.

"Edward T. Babbs sent this valuable sample card.

—Mabel Bryant."

"John, where did you get the attractive house?"

"I was taking a model of a seaplane to Chandler & Farquhar, Boston, well-known dealers in hardware, who were holding an amateurs' contest. In there I saw a model of a house which

I wanted for this demonstration. I talked with the man in charge of the contest and asked him if I might borrow the house. He said that he would see the owner after the contest was over, and make arrangements. I told my mother about seeing this house, and she told me there was a doll-house right next door. She told me this late at night, and the next morning I immediately went next door and told the girl and her father my story. The doll-house was shown to me and proved to be just what I wanted. Mr. Wilkins, the girl's father, said that if the house was of any use he would gladly lend it to me. I offered to wire the house for the girl."

"Well, you boys can wire it now, and later you can tell us about it."

"Helen, will you give the report of your meetings?"

"An entire report of all the meetings of our club. Well, that's not so very hard to do. We had such interesting times at each and every one that really it's fun to remember. At our first meeting the first thing we did was to congratulate each other on being in this particular club. We thought the group work the most splendid idea. Then we got down to business. We decided that we would work as hard as any club of girls could, and if hard work could accomplish anything, we would have the best book possible.

"Theodosia Clapp was then elected chairman, and Helen Dunlea, secretary.

"As we had already taken Health as the subject of our book, we then decided on the book itself. Helen said she would go to Andy's Print Shop and see if she could get a book cover cut out in the shape of a circle. We wanted a white leather cover with the title printed in gold. We then changed our name to the 'Life Savers,' after much discussion. Each girl was to take two subjects about Health, so as to make eight chapters. Gladys, the best penman of us all, said she would write the book. Now, with that overpowering object in view she would not have to compose any chapters.

"We were somewhat ahead of the rest of the room in our planning, but we didn't mind that little thing, and rushed on regardless of speed. Consequently at our second meeting for the books we had so much to talk about that the proverb about

a woman's tongue was absurdly true. Our cover was promised and each one brought money to pay for it. We then proportioned out chapters. There was to be about 200 pages in all. Many letters had been written and each girl was working splendidly. Helen and Gladys volunteered to go to the Health Show and Helen, as secretary, promised to gather samples and take notes.

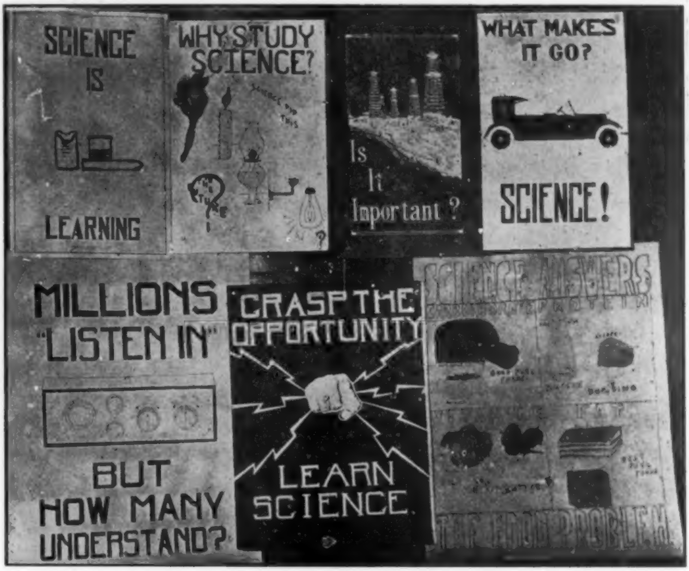

Fig. 2. A Group of Club Posters.

Between the fifth and sixth meetings something horrid almost happened. The printer declared he could not make the book cover at the price first agreed upon, and as each girl personally felt she would not like to pay more, our chairman took our troubles to the only real standby, her mother. We were soon out of difficulties, for she got a cover for us at one-fifth the original price. We then declared we would privately tell Mrs. Clapp that she was a darling.

"At our sixth meeting the chairman turned the meeting over to the secretary, who then told the other girls about the Health

Show and gave them many pamphlets, specimens, etc., that she had brought home. The next week one of the girls was going to the Food Fair. We thanked Gladys for going, as she really was not obliged to, but in doing so we claim she showed the proper spirit.

Fig. 3. A Group of Club Books: Granite, by the Pinkies. Wool: Its Romance, by the Six Lambs. The Six Shoemakers. Wood, by the Four Woodchucks. From Stylus to Corona, by the Five Scribes. Health, by the Life-Savers. The Science of Building, by the Four Beavers. Oil, by the Six Gushers. Radio, by the Five Detectors.

"We tried a rhyming scheme for our preface. Do you think you could remember it, Sarah."

PREFACE OF "LIFE SAVERS" BOOK

This book is prepared by the "Life Savers,"
And five our number will be:
There's Gladys and Helen and Sarah
And Ruth, you know, and me.
We are now prepared to prove to you
That health is essential to all,
We have many a poster and pamphlet
From firms who allowed us to call.
We hope you'll enjoy our efforts
And note this book the best;
And though it may not be *Senior* proof
We trust it will stand the test.

"Now, all we can say, if our book does not come up to expectations, is, that we have tried, and after all, what can anyone do but try."

"Bert, seeing that your group of the 'Four Shoemakers' have received more samples and letters than any of the others, we would be pleased if you would tell us about some of them."

"Owing to the lack of time we cannot speak at length about the scientific points of the shoe industry, but we will speak on it briefly.

"Tanning, as it is called, is really the conversion of hides and skins into material we call leather. The hides and skins are received at the tanneries in three distinct forms, namely, green salted, dry, and dry salted. The first thing the tanners do is to sort the hides. The purpose is that a large percentage can be for sole leather instead of upper leather. The hides and skins are then placed into a weak solution of acid. The purpose of the acid is to speed the penetration of the moisture, so that the fibers may be more rapidly softened.

"After several hours the hides are then placed into a solution of lime and arsenic, so that the pores may open and the hairs be removed. After going through many similar operations the heavy hides arrive in the sole leather room, where they are placed in a solution of chemicals. After six months the hides are back and, if tanned, they can be used for inner-soles and outer-soles. The skins and the light hides arrive in the finishing department. If patent leather is desired, two coats of varnish are placed on the hides and they are skinned and sent into the oven, where at the bottom the oven is lined with steam-pipes. Heat drys the varnish evenly. Later the skins and hides are placed in the sun to dry. Then they are ready to be used for upper leather.

PROCESS OF SHOE.

"After the leather is received in the shoe factory, it is distributed to the cutter, who selects the best part of the skins for the vamp and the remainder for quarters. Then the uppers are sent to the next room, where the lining is cut and the size of the shoe stamped and all the miscellaneous trimmings are cut so that the shoe is ready to be stitched. During all this time the innersoles and outersoles are being prepared in the sole leather room. The upper is sent into the stitching room where all the parts are united and ready to be lasted. The lasting being the entire durability of the shoe depends upon the amount of good work done by the operators.

"The first man who receives the shoe places an innersole on the last, and he then puts a counter with a little quantity of paste into the upper and is then adjusted on the last by tacking

a tack on the back of the last. The next operator places a box toe which is heated then places the shoe in a machine that adjusts the vamp to the desired place on the last and pushing the pedal, three tacks are driven on the last, one on the toe and one on each side. When the side laster receives the shoe he passes the side of the shoe to the bed laster who drives small tacks on the heel site and he also places a piece of wire so as to hold the box toe. The shoe is stapled and the tacks are taken out with the exception of the heel seat. The shoe is then ready to be welted where a small strip of leather is placed around the edge, the surplus is then taken off and the welt slashed, then a shank and a cork is placed on the bottom of the shoe and cemented. The soles are also cemented. When dried, they are attached together and the surplus leather is taken off and a channel is opened on the bottom of the shoe. The stitcher stitches the shoe and the shoe is cemented in the channel and when dry the shoes are taken out and the heel is placed on the shoe and the surplus leather is taken off and is ready to be scorned.

"The heel scorn smooths the heel with carborundum, which is attached to his machine. Then the edge is made even and stained by the next operator who polished it after the stain is dry. The operation is done to the heel.

"The buffer receives the shoes next and he buffs the bottom with carborundum which is attached to his machine. Then next man stains the bottom which is polished and sent into the packing room where the wrinkles are ironed out and the scratches are filled in and they are ready for the customer.

(Explains each step with actual material. Best exhibit.)

"Tell us how you wired your house, Billie."

"As our book pertains to the comforts of our home, we thought it appropriate to give a short demonstration on wiring.

"Our homes are supplied by the Malden Electric Company. This company has large plants throughout New England. Their largest station is in Salem.

"Electricity is generated from steam and sent over high tension wires to Malden. The electricity is then transformed down into 110 v. Over an extensive system we receive our supply.

"The current goes through a meter which registers the electricity by Kilowatt Hrs. Wires conduct it through as many fuses as the electricians deem necessary and it is then led through the different rooms.

"As our homes are wired comparatively the same as this model we have secured, with the difference of the electric supply which are batteries, we will tell how this is wired.

"It may be interesting to know a few things about a battery. A battery is a device for converting chemical energy into electrical energy. They contain two parts, the carbon being the (Positive) and the zinc (Negative). We set up our dry cells in a series.

"Two wires are taken from the batteries and led into the house. The positive must be kept from the negative, as it will cause a short-circuit. In each socket the + is put on one side and the — on the other. When the bulb is put into the socket it is lighted by the circuit formed between the + and the —.

"Any let-off may be taken from the main line."

Through the house he tells how wires are brought into each room in the doll-house.

"As our books have not yet been completed, we will hold our last meeting here, and I will give you four minutes in which to make your books a finished product.

"Will you please hand me the books? These are the books, which, not only this division, but others also have composed.

"The following are some of the other names:

1. "Granite," by "The Pinkies."
2. "The Story of Good Food," by "The Dietitians."
3. "Flour," by "The White Caps."
4. "The Secrets of Beauty," by "The Beauties."
5. "Inventions," by "The Busy Bees."
6. "Gases," by "The Invisible Brownies."
7. "Wood," by "The Four Woodchucks."
8. "Oil," by "The Six Gushers."
9. "Automobiles," by "The Five Chugs."
10. "Fire," by "The Four Smoke Eeaters."
11. "Submarines," by "The Deep Sea Divers."

"Can any one tell me why you like to study science this way?"

1. *Phyllis.* "We become more friendly and chummy, although we had a few scraps that made us understand each other better."

2. *Lena.* "We enjoyed the good times we had at each others' houses and also the discussions which came up about different facts each week."

3. *John.* "1. This club work takes away the feeling of drudgery and a feeling of freedom is substituted in its place. 2. Our parents have helped us every time they were able to and they were as interested and excited about our books as we were ourselves. 3. If any members of our group had a suggestion that was better than our own, we gave in to their plan and by this we became unselfish. 4. We all tried to play fair, to be generous and sportsmanlike, to be honest, not only with members of the groups, but also with all the other groups."

4. *Richard.* "We like to write letters to firms and we were surprised and pleased to receive samples, exhibits and information."

Finally the time allotted for the completion of the books comes to an end and the group submits the result of its labors.

This idea of group work is, I believe, original, but I believe strongly that it is one of the biggest things I do in socializing the science course. Through it I am able to include the pupil, the parent and the community. It makes my teaching more stimulating, more attractive, more useful and more practical, without in any way detracting from the seriousness and value of science study. The buzz of voices may, perhaps, be an object of disapproval to some teachers, but my experience has been that the pupils like the work so much that they are willing to try to moderate their voices in order that they may continue the work.

Almost without exception the students expressed their appreciation of this type of work and they were quick to see its value to themselves. They spoke of the "team work" which the group idea called for; the interests which it gave them in the science course; the new information which they obtained, the existence of which they had scarcely dreamed; the way which the work touched upon the other branches of school work; the interest and co-operation which were shown at home and the happiness which came to them in accomplishing something.

The members of the clubs enjoyed reading and reporting on the books of the other clubs.

In other ways than these, however, the work was helping the pupils. It was developing in them mental alertness and curiosity; thoroughness and stick-to-it-iveness. The work was carried out in a spirit of wholesome rivalry and competition. They were taxing their inventive powers to make their particular books as attractive or as complete as possible. They had to use their judgment in the selection of samples, of matter to be included or left out. And not least of all, they were getting considerable training for future citizenship. For the group could continue only while the members of the group were loyal to one another. Anything like jealousy in a group was quickly frowned on. Courtesy and co-operation with one another was a requisite for success. To play fair, to be generous and sportsmanlike, to be honest, not only with the members of the group, but also with all the groups—these ideas, too, were being brought home to them.

It would be false to say that one hundred per cent of the pupils profited one hundred per cent from the working out of this idea. It would be untrue, too, to assert that all the pupils, without exception, threw themselves wholeheartedly into the the work. But the results accomplished were very much worth while and the "books" were uniformly good. The habit of thought and work which the pupils were acquiring and their awakened interest in the class of science, together with the new information which they gleaned, gives me great confidence in this nature of group work as a helpful method of socializing science teaching.

An idea or a method which tends to enhance the work of the class room, which influences the fledgling mind of the pupil for good, which has a healthy reaction on the community at large, and which makes for a more useful and higher type of citizenship, must be given a hearing.

Two Sunshine Chemists, Chloro and Phyll

O. E. Underhill, Amesbury, Massachusetts.

The science supervisor is out on an informal hike with a group of boys and girls. It is a warm spring day. The teacher is sitting on a rock, the children grouped around him. Some of the girls are making leaf chains. The teacher picks up a leaf and speaks:

Teacher.—Do you know that there is a whole chemical laboratory in this leaf? And a manufacturing plant?

Chorus.—Oh, tell us about it.

T.—Two chemists work in this laboratory: Chloro and Phyll. As they are man and wife and always work together as one, we will speak of them both together, and call them Chlorophyll. I think they must come from Ireland, because they always dress in green when they are at work. They take their vacation in the winter, when you are at school, and work in the summer, when you are playing. When they get ready to go on their vacation they deck themselves out in beautiful reds and yellows and warm browns.

Alice.—What is made in this factory?

T.—They make a great many things in these leaf factories. Perhaps the most important thing is food. Is it potatoes you want? These chemists, chlorophyll, work away in the tops of the potato plant, making food and storing it down cellar in the storeroom, ready for you to eat. Is it bread that is to be made? These chemists, in their wheatstalk factories, store the materials in the grain of wheat from which the flour is made that goes into your bread.

Beatrice.—Do these chemists make all the food?

Charles.—What do they make it from?

Alice.—You said they make other things besides food?

T.—Yes, Beatrice, in one way these chemists make all our food.

Beatrice.—How do they make milk and eggs and beef and—lots of things like that?

T.—What do the cows and the hens live on, Beatrice?

B.—Why cows live on grass and hay, and hens live on corn and wheat and things.

T.—Our chemists, chlorophyll, manufacture food in the grass and in the wheat and in the corn. The cows take that food and make it into milk and beef. The hens make it into eggs.

Charles.—Then the cows and the hens are factories, too, and make one thing from another.

Dora.—That's like making paper. My brother works in a factory in Maine where they take logs and make them into what they call pulp. This pulp is shipped to other factories, where it is made into paper.

T.—Yes, Dora, that is it exactly. Now, Alice, you wanted to know if they make other things besides food. They make houses and clothes and——

Alice.—Why, that sounds silly. What have leaves to do with our houses and clothes? We don't make grass houses now, and it has been a long time since Eve wore a fig-leaf.

T.—What are our houses made of, Alice?

A.—Mine's made of wood, mostly. Oh, I see. Wood and leaves both come from trees. But the trees make the leaves, the leaves don't make the tree.

T.—You couldn't have the tree without the leaves, Alice. Which comes first, the leaf or the tree?

A.—Why, the trees, of course.

T.—Are you sure of that, Alice?

Charles.—I have seen places where seeds from maple trees have fallen and sprouted. They send out two tiny leaves.

Beatrice.—And I have seen pine seedlings. The green part grows first.

T.—Yes. You two are more observing than Alice. The leaves, or green part, with our chemists, are packed away in the seed. When the seed sprouts the leaves come out first and the factory begins to make food out of which the rest of the plant is formed. So you see, Alice, the leaves really make the trunk of our tree. Out of the trunk we make paper and lumber and hundreds of things.

Dora.—But how about our clothes? You said they made our clothes.

T.—Cotton is made from the fibers of the blossom of a plant —with green leaves. So also is linen made from the fibers of

a plant. Wool somes from the sheep—which feeds on grass. Silk comes from the silkworm—which feeds on mulberry leaves.

Charles.—But what is it made from?

Earl.—What does the plant make, that animals make into the kind of food we eat?

T.—I think I will have to put you off again, Charles, and answer Earl's question first. Then I will answer yours. The chemists in the leaves make one thing only. Then this in turn is changed by other chemists to a large number of things. The chemists, chlorophyll, in the leaf, take the raw materials (I will tell you where they come from in a minute, Charles), and after putting them through one or two changes make them into starch.

Alice.—The same kind of starch mother uses?

T.—Yes, the same kind. In fact, the starch your mother uses is taken from the corn or the potatoes after it has been made by the leaves of those plants. Then some of the other chemists I spoke about, change the starch into sugar.

Beatrice.—The kind we put in our cocoa?

T.—Sometimes it is and sometimes it is not. There are several things a chemist calls sugar. To him they each have a different name, and he calls them all sugars. It is like a lot of different makes of automobiles. One person may have a Buick, another a Packard, another a Ford, but they are all called automobiles. Different plants make different kinds of sugars. The one that is made by the sugar cane, from which we get our sugar, is called by the chemist *sucrose,* and that is what we mean when we speak of sugar. Out of these things other chemists which live in the plant make other things from which we make cloth or paper or lumber. These things which are made in the leaf are very much alike in some ways and are all put together in one group. This group has a long name. I doubt if you can remember it, but I wish you to try. Anything which belongs to this group is said to be a carbohydrate, and all of these things together which belong to this group are carbohydrates.

Dora.—That is a long name, isn't it?

T.—Yes. I will try and tell you something about the name to help you remember it. Let us divide it in halves. Take

the first half, *carbo*. I will write it in the dirt with this stick—*c-a-r-b-o*. Does it look or sound like anything you are familiar with?

Charles.—It is almost carbon.

T.—What is carbon, Charles?

C.—It is a black substance and coal is mostly made up of it.

Dora.—You told us once that the diamond was a pure form of carbon.

T.—Yes, that is true. One of the things in carbohydrates is carbon. Now for the other half of the word. I wonder if any of you can think of a word that has *hydrate*, or something like that as a part of the word.

John.—Hydroplane.

Alice.—Hydrant.

T.—What is a hydroplane, John?

J.—An airplane that can go on water.

T.—What is a hydrant, Alice?

A.—Something that water comes out of, to put out fires?

T.—Can any of you see any point of likeness between a hydroplane and a hydrant?

A.—I don't see how they are alike.

T.—A hydroplane goes on water, and a hydrant is something water comes out of.

A.—Oh! water?

T.—Yes, that is it. *Hydro* is a Greek work for water, and is often put with other words to name things which have to do with water. The last half of our word is hydrate, because carbohydrates have in them, besides carbon, the same things that go to make up water.

Charles.—I remember. Water is made up of two gases, hydrogen and oxygen. You showed us a bottle of the two gases, and when you mixed them together in a dry bottle and touched a candle to the mouth, it exploded with a bang. Then there was left a mist on the surface of the bottle inside, which you said was water.

T.—That is right, Charles. I am pleased to find that you have remembered so well what I have told you. Can anyone tell me what a carbohydrate is now?

Alice—Carbon and water.

T.—Not quite right, Alice. There is no water there as water. The things are there that are in water, and they are in the same proportions.

Charles.—A carbohydrate is a substance that contains carbon, and hydrogen and oxygen in the same proportions as water.

T.—That is quite right. Try and remember it. Now, Charles, let us try and answer your question as to what the chlorophyll make the carbohydrates from. (You see I am going to use the long word now that I am sure you know what it means.) In order to manufacture these carbohydrates, then, the chemists, chlorophyll, must have sent to their factory the three things from which carbohydrates are made: that is, carbon, hydrogen and oxygen.

Charles.—The hydrogen and oxygen might be in the water. You have to give a plant water or it will not grow. The water would have them in just the right proportions, too.

Alice.—But you don't feed plants on charcoal. Where does the carbon come from?

T.—Charles is right. The hydrogen and oxygen come from the water. The carbon comes from the air, Alice.

A.—But there is no carbon in the air.

T.—Ah, Alice, you have forgotten so soon.

Charles.—I know. The air has lots of things in it. Water, oxygen, nitrogen, and a gas which we breathe out. You called it carbon dioxide, because it had one part of carbon and two parts of oxygen. You had some in a bottle, and when you put a colorless liquid with it, it turned like milk. I blew through a tube into some of the liquid and that turned it white, too. Then we left some in a dish over night and it was a milky color. So it must be the same gas in the air that we breath out and that you had in the bottle. If it is in the air and it has carbon in it, perhaps the chemists in the leaves can get it out and use it to make the food. It has oxygen in it, too.

T.—Charles again. What a good memory you have. Our manufacturing plant in the leaf takes the air through openings, much as the air is taken into your schoolroom through ventilators on the roof, only the openings in the leaf are not on the roof, but underneath. These openings are a very interesting part of our factory and I will tell you some more about them

some time, if you have the time and you wish to hear about them. Our chemists, chlorophyll, take the carbon from the carbon-dioxide of the air and put it with the water that comes up from the roots of the plants, to make starch and sugar and other carbohydrates. You see that the oxygen that was with the carbon is left over, so the plant throws it away,—back into the air again. Is it not a wonderful thing that this wonderful machine, our body, should eat up food to make us live and move, and throw away into the air carbon-dioxide, all the while taking oxygen out of the air; while plants take this carbon-dioxide that we throw away, to make into food for us to eat again, and throw away the oxygen which we need to keep us alive?

Beatrice.—Why, it is a regular circle, isn't it?

T.—There is one point we haven't spoken of yet. You will find that whenever a factory makes things, it has to have fire or steam or electricity; some form of energy to make things go. So, too, our chemists in the leaves cannot run their factory and make food, without something to make it go.

Earl.—Yes, a plant has to be warm or it will not grow.

T.—Does a plant need anything else besides water, air, and warmth, in order to grow?

A.—You can't grow plants in the dark. Mother always sets her geraniums in the window, so that they will get lots of sun.

T.—Yes. A plant must have warmth and sunlight in order to run its factory,and these both come from the sun. The chlorophyll, with the help of the sun, puts the carbon from the carbon-dioxide of the air with the water from the ground, to make carbohydrates.

Alice.—My, that's an awful lot to say.

T.—You can say it all in one word, if you wish.

A.—No, really?

T.—Yes. Photosynthesis.

A.—That's Greek to me.

T.—It is to me, too.

A.—You mean you don't understand it?

T.—No, Alice, I wasn't using it as a slang phrase for not understanding. It really is Greek. It is two Greek words. The first one, *photo,* means light. You have it in photograph,

a writing or picture by light. *Synthesis* means putting together. So the word, *photosynthesis,* means putting together by light. This is what the chemists, chlorophyll, do with the air and the water. They put them together by sunlight to form food for the rest of the plant, and indirectly, food for animals and for us.

Dora.—You said you would tell us about the holes in the leaf that the air goes in through.

T.—Some time, when we are at school, Dora, where there is a microscope, I will show you some of those holes and tell you something about the machinery that is in this leaf factory, but it is late now and we must be getting home.

Safety Teaching in our Schools [1]

WHATEVER may be our general attitude toward using the schools for the teaching of such subjects as safety, we must admit that a situation exists at present which the schools cannot disregard. With 20,000 children of school age being killed by accidents each year, with 15,000 people being killed by automobiles each year, a number that is rapidly growing, with a fire loss measured in 14,000 lives and five hundred million dollars' worth of property destroyed, the school must come to the rescue in helping to solve a problem which has proved too much for the home, unaided, and particularly since actual experience in the schools themselves shows that a 50 per cent saving in lives can be had, that is a saving of the lives of 10,000 school children each year.

In the first place, nothing can be more important in a child's

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1 Abstract of address given by Albert W. Whitney, secretary of the Education Section, National Safety Council, N. Y. C., February 27, 1924, before the National Education Association, Chicago.

life than an adequate conception of the world as a place that is ordered, or subject to order, and of life as a purposeful thing. This must be the basis for all effective cultural development, and the basis particularly for law and ethics and religion.

The degree of passionate interest that children display in this work is a matter for perpetual astonishment; it comes to them in the nature of a crusade, and is an outlet for the kind of emotion that goes into patriotism and kindred sentiments. This shows how close it lies to the heart of life, and also, perhaps, how the sense of tragedy in physical accident has not yet been dulled by a sense that comes later of the still greater tragedies that are implicit in life.

The key to the problem is unquestionably education. The main features of the teaching technique have been developed and have been in operation in enough schools a sufficient length of time to show that the plan has been worked out along essentially right lines.

While there is much still to be done in the development of detail and perhaps of fundamental principles and in checking all this up, the preeminent need of today is the actual getting of the work into the schools. The National Safety Council is solving this problem by encouraging the formation of what we call demonstration centers. A demonstration center is a school that is not only willing to put in safety education, or it may be one that has already had it in operation, but it agrees to prepare a special demonstration on a given date for the benefit of other schools in the region, and to be ready from time to time as the need may arise, to show how the work is done.

Last year, during only a limited part of the school term, eleven such administration centers were organized; these reached about 1,600 teachers outside of the schools that acted as demonstration centers. This year, with a field secretary giving her whole time to this work, we expect to make rapid progress, and it should be a matter of only a few years before the United States will, from this point of view, be pretty well organized; it will, that is, be possible for any school that desires to put in the work to visit some school in the vicinity where the work is being carried on.

Organization of General Science in the Seventh and Eighth Grades of the Junior High School and the Ninth Grade of the Four-Year High School.[1]

IRA C. DAVIS, University High School,
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THE statement has been made frequently that general science is unorganized; that it is a piecemeal mixture of science. If we consider the subject-matter presented in ten of the most recent textbooks, it is found that there is about seventy per cent of agreement in this subject-matter. This per cent of agreement in general science is greater than in many other courses of study.

A large number of science teachers follow the exact order of the textbook. As far as actual teaching is concerned, the subject-matter presented agrees almost wholly with the textbook. These textbooks are organized largely according to the opinions of the authors. Many of these authors have made intensive studies of the subject-matter that should be presented to boys and girls. Again, some teachers have attempted to outline their own courses of study, with the usual result that undue emphasis is placed upon some special phase of the subject-matter.

If a summary is made of the different attempts to organize courses of study, it is found possible to group these attempts:

1. Courses of study as developed in textbooks.
2. Special courses, usually placing emphasis upon some special phase of science.
3. Courses made for some particular locality.
4. Separate courses made for boys and girls.
5. Courses made by selecting the most important units in each branch of science and attempting to group them into some coherent form.
6. Courses built upon the interests of the pupils.
7. Courses combining civics and science into our so-called courses in civic science.

In the organization of subject-matter, the first factors to be considered are the aims to be developed in the teaching of

1 Read before the Central Association of Science and Mathematics Teachers at Indianapolis, Nov. 30, 1923.

general science. If consensus of general science teachers is taken, it is found that the most important aim is to acquaint the pupils with their environment. This should be followed by stressing the necessity of the pupils gaining a large number of valuable scientific facts. Personally, I believe the most important aim is to develop the scientific method of solving a problem. In what other subject does a pupil have an opportunity to learn how to use the scientific method? The scientific method includes the acquisition of a method of working, a willingness to suspend judgment until the problem has been thoroughly mastered, and the ability to draw some definite conclusions from the facts and data presented.

Teachers often make the statement that pupils in general science are unable to use the scientific method; that it is a waste of time to attempt to develop the method. If pupils in general science could use the scientific method at the beginning of the course, there would be no object in offering such a course. Pupils are unable to use the scientific method at the beginning of the course. They can, however, learn how to use it. Teachers often forget that it is their duty to teach pupils something, not to find out what they don't know.

In the organization of a course of study in general science the most important factor to determine is: What is the average environment of a boy or girl? Follow this by the development of a plan which will train the pupils in the best methods of studying and understanding this environment. How far have our present courses in general science fulfilled these aims? While there has been considerable agreement in subject-matter, there has been very little agreement in the best methods of teaching this subject-matter, with the inevitable result that we have very few teachers trained to teach general science.

The normal activities of boys and girls center around a few simple things. They are constantly in contact with simple scientific facts and principles. While the activities of certain individuals may vary to a considerable degree, by and large, all boys and girls are interested in practically the same things. It is possible to group all of these activities:

1. Eating, or Foods.
2. Play and entertainment.
3. Sleep.

4. Reading.
5. Talking.
6. Working, including going to school.
7. Keeping warm or cool.
8. Clothing themselves.
9. Moving from one place to another.

What science can best explain these activities to boys and girls?

In organizing these activities into a coherent, progressively difficult course, several problems must be considered:

1. The maturity of the pupils.
2. The length of the class period or the length of the course.
3. The training of the average teacher.
4. The equipment found in the average school.
5. The training of the pupils in science.
6. The number of pupils taking advanced courses in science.
7. The aims to be developed in teaching.
8. The training in the ability of the pupils to solve problems of of increasing difficulty, or the ability of the pupils to use the information they have gained in attacking new problems.

The most important problem to be considered is the teacher. We cannot plan our courses for the exceptional teacher. These teachers can take care of themselves, but unfortunately this number is far too small. The courses must be organized so thoroughly that an ordinary teacher can teach with the equipment found in the average school. This does not imply in the least that allowance is not to be made for improvement in equipment and progress in teaching, but it does imply that if our ordinary teacher is to achieve any success in the teaching of general science, the organization of the course must be left to our exceptional teachers. If our exceptional teachers cannot organize the subject-matter for a course in general science, how can we expect the ordinary teacher to do it? This ought to be argument enough against the statement that all of our teachers ought to be encouraged to organize their courses of study in general science.

Pupils in the seventh, eighth and ninth grades do not differ to any large degree in their ability to understand science. The pupils in the lower grades make slower progress at the beginning, largely due to their inability to express themselves thoroughly in written work. Pupils in general science can follow directions for experimental work practically as well as pupils

in advanced courses in science. They have difficulty in drawing conclusions in many instances, but pupils in all science classes have the same difficulty. In many instances the pupils in the lower grades are better experimenters. Their preconceived notions about certain phenomena are not so well fixed. If new methods are sought for proving certain principles, their suggestions or solutions are just as feasible as are the suggestions of the pupils in more advanced courses in science. The argument against general science that it is too difficult for the pupils of the seventh, eighth or ninth grades is not proven by the experiences of teachers working with pupils of these grades.

The equipment for general science is far from being adequate. While many schools have a fairly good supply of demonstration apparatus, they are woefully lacking in sufficient apparatus for the pupils to work with in the laboratory. The apparatus needed is not expensive, and with careful planning on the part of the teacher, it ought to be possible for the schools to secure enough apparatus for the pupils to work with in the laboratory. Several sections or classes can use the same material. In most schools, adequate apparatus for one class is all that is needed.

Most schools offering general science have it a full year in the ninth grade, while others offer it only a part of the year. In schools with a junior high school organization, general science is offered either one or two years from three to five days a week. The first year of the high school is crowded with required subjects. Adding general science to this list still further complicates the problem. If a high school can be organized on the six-three-three plan, general science can best be placed in the seventh and eighth grades. If the junior high school is a field of exploration, then it is not unreasonable to ask that general science be required of practically all of the pupils. A pupil does not know whether or not he likes science until he has had an opportunity to study science. To accomplish this plan it is necessary to adopt the hour period for all classes during the day. The old forty to forty-five minute period is too short, while a double laboratory period is not needed for laboratory work in general science.

It is not the most important aim in general science to prepare pupils for advanced courses in science. The pupils have

had general training in mathematics, English, history, etc. They are prepared to enter the specialized courses in those fields when they begin high school. This is not the condition in science. Our teachers in the advanced courses in science complain that general science deadens the interest in these sciences. Teachers of English and mathematics do not attempt to belittle the work done by the pupils in these subjects, simply because the work was not done in high school. The teachers of these subjects have adapted their courses to the needs and abilities of the pupils as they find them. Many of our science teachers seem to have the impression that interest in any subject depends upon the ignorance of the pupils when they begin the subject. The pupils should have a general foundation in science, and this can only be secured by giving a thorough course in general science.

If all of our pupils were required to take all of the sciences, as pupils are required to do in English, and provided all of them remained in school, then it would be a simple matter to teach certain fundamental units of science each year. Many pupils will leave school before they reach the tenth grade; a few more will not take advanced courses in science; while many of those that do remain will take at least one advanced course in science. It is not possible to differentiate enough in our courses in general science to meet all of these needs as found in most of our schools. Statistics show that for every one hundred pupils in the fifth grade, only sixty-three finish the eighth grade, thirty-seven enter the ninth grade, and twelve finish high school. Of the one hundred pupils in the fifth grade, nearly three-fourths of them have left school before they have completed the ninth grade. Of the twenty-five pupils remaining in the high school after the ninth grade, not more than ten will take any courses in the advanced sciences. While statistics show that out of every one hundred pupils in the fifth grade ten will take advanced courses in science, no one knows which these ten will be. Is it possible that our science teachers will oppose the opportunity of our boys and girls studying science in the seventh, eighth and ninth grades, when stactictics prove that only one-fourth of the pupils will remain in school after that time?

The aims of general science should be developed in correlation with the subject-matter. Is there a gradual increase in difficulty in the subject-matter? Are pupils able to solve more complex problems as they progress in their work? Are pupils given opportunities to use the information they already possess in attacking new problems, or in other words, are the pupils given plenty of opportunity to think? The real test of general science is the ability of the pupils to formulate methods of studying the scientific problems in their environment and their ability to make use of the solutions of these problems in the better understanding of themselves.

In organizing the activities of boys and girls into teaching units, it is found that the list of these units is not large; neither is there a great deal of difference in the science to be taught boys and girls in the same or different localities. The principles remain practically the same while some of the applications may differ.

Probably the most important activity of a boy or girl is eating. This requires a thorough study of foods. What should he know about the sources of their foods, real food values, digestion, etc. It also includes a study of water, air, light and health. The study of foods then would include a study pupils know about their foods? In the study of foods, pupils of animals, plants, air. water, heat, light and health.

In play or entertainment, the main sources of amusement built upon the principles of machines, chemical sets, electrical come from toys of some kind. These can be grouped into toys toys, magic lanterns, radio, or some sort of musical instrument. In play, then, machines, simple chemistry, electricity, light and sound, are some important problems to be considered.

In sleeping, breathing pure air is important. The necessity of rest is also important. In sleep, breathing, pure air, ventilation and health are the most important topics. In reading, the principles of the reflection and refraction of light are important. The eye and the camera are compared. The main topic then is light. In talking, the principles of sound are important. The production of sound, musical instruments, echoes, etc., are commonly included in the study of sound.

In working, the activities of boys and girls will differ. A

girl can apply science in washing dishes or any other phase of housework, while the same will hold true for boys in their different phases of work. Practically all of the different phases of science will enter into the work performed by boys and girls.

In keeping themselves warm or cold, a study would be made of textiles, climate, heat, light, building of houses, etc., while clothing themselves would be included in the study of the same topics. In moving around, the automobile, airplane, bicycle, etc., would be included. Practically all of these would require the study of machines.

The units that are fundamental to the teaching of general science must be arranged in some coherent form. In doing this it is necessary to consider:

1. The possibility of demonstration of or experimentation with the subject-matter.
2. The seasons.
3. The difficulties to be encountered in each unit.
4. The possibility of the use of projects.

If we take these factors into consideration, the best possible order to arrange these units is the following:

1. Air.
2. Water.
3. Heat.
4. Light.
5. Sound.
6. Electricity.
7. Energy and machines.
8. Simple chemistry.
9. Soils.
10. Plants.
11. Animals.
12. Clothing.
13. Foods.
14. Modern scientific development.

No attempt has been made to differentiate the different sciences in this organization; neither has any special emphasis been placed upon any branch of science. In teaching air, for example, no attempt is made to differentiate the physical and biological sciences. A study of health should be emphasized constantly in the teaching of all of the units. The units are not equally important, yet undue emphasis should not be given to any unit to the exclusion of others. The main units should be broken up into smaller teaching units. Each unit should contribute to the solution of the main problem and in many instances to the solutions of problems that are to follow. These smaller units should be made to correlate with the real problems the boys and girls meet outside of school. When neces-

sary, different applications can be made for boys and girls, and some provision may be made for the differences in the abilities of the different pupils.

What method of teaching best fulfills the aims to be developed in general science? The experiment-problem-project method fulfills all of the aims of general science. In our experiments the directions are written for the pupils. In the problem the pupils write their own directions. At the beginning the problems are simple, usually containing only one factor. The problems gradually become more difficult. A project is a group of related problems. But again, the pupils organize their own methods of procedure. We cannot expect pupils to work on a project at the beginning of a course in general science. Pupils must learn how to use the scientific method before they can work projects with any satisfactory results.

In teaching general science we must, at the beginning, teach the pupils how to experiment. After the pupils have performed an experiment according to directions, ask them to solve problems similar to the experiment. Encourage pupils to offer suggestions for the solutions of these problems. In many instances the best solutions of these problems can be demonstrated to the other members of the group. By combining judiciously experimentation by the pupils, demonstration by the teacher, and the solutions of problems by the pupils, progress can be made in the development of the scientific method. The reading of books, class discussions, applications of principles demonstrated, all enter into the procedure.

Many problems solved lead to the solution of many more problems. New problems are constantly arising out of such a class procedure. A class procedure like this gradually leads up to more complicated problems and projects. These projects should be the culmination of the year's work. The pupils have had an opportunity to select their projects wisely. These projects should be something the pupils are interested in and something they think is worth while.

The pupils must organize their own methods of procedure; they must devise their own methods of attack for the many problems to be solved, and they must organize their results into some coherent form, or arrive at some definite conclusion. In addition to this, each pupil must demonstrate his results to the

other members of the group. In this way pupils take part in the solution of many projects. They have an opportunity to see many different methods of procedure with the consequent differences in types of attack. This varied experience gained by pupils in the working out of projects in school ought to prepare them for the solution of projects after they leave school.

The method advocated for the teaching of general science can be developed by all of our teachers. It does not need a new set of equipment or a new environment. It can be placed in operation in all of our schools with slight modifications. It needs a teacher with an eagerness to attempt to train pupils in the scientific method of attack. The acquisition of facts and the ability to begin to use the scientific method makes it possible for boys and girls to better understand and appreciate their environment.

Man-Made Stones [1]

B. CLIFFORD HENDRICKS, Teachers College,
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ONCE upon a time, a long time ago (as the story goes), a wild man ran into a dark cave—perhaps made as was Mammoth Cave—and rolled a huge stone into the opening. He was trying to run away from a mountain lion, and found this a surprisingly easy way to escape. The cave suited him so well as a place of safety, and also in other ways, that he soon adopted it for his dwelling place. Because of this use of the cave for his house, he has since been called the *cave man*.

Mother Nature made this first stone house for man, but he soon discovered that she did not always place houses just where he wished to live. To overcome this difficulty he undertook to make them for himself. It was quite natural for him to try to make them of stones, but there were always cracks between the stones after he had piled them together, and through these cracks came the cold winds of winter and the soaking rains of summer. He probably first used ordinary mud to "chink" the cracks, but the rain washed it out. And, too, mud didn't add very much to the strength of his wall.

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1 Printed by courtesy of "Normal Instructor and Primary Plans," from October number, 1923.

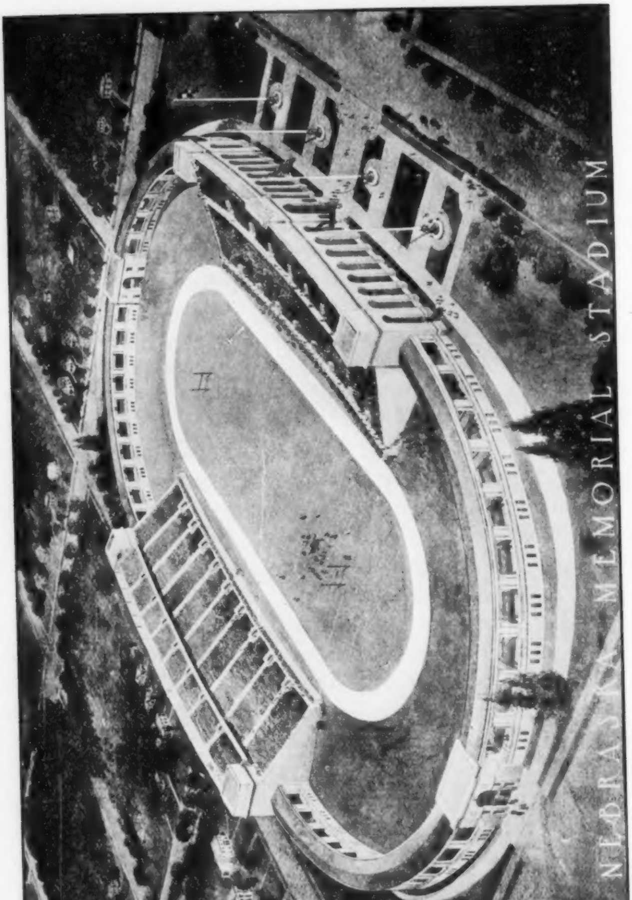
Without telling just how, he learned what to do. Long, long after he did this first "chinking," we find him using not mud but a whitish-appearing material which he called mortar. He used it not only to fill the cracks between the stones of his artificial cave, but to fill cracks between the logs in his log cabin, and also to cover and make a smooth wall upon the inside of his house. When the mortar was thus used he called it plaster.

Just what was this mortar which he found so helpful in his house building? When our chemist hears our question, he takes a piece of mortar, which, he says, can be found in the structure of the older buildings standing even today, and puts it into his test tube. He pours over it some acid—either vinegar acid or storage battery acid will do. What is noticed coming up through the acid? By putting a one-hole rubber stopper, with glass and rubber tubing properly attached, he leads some of this gas through lime water. What does it do to the lime water? What does this tell us about the gas that is bubbling through? A look into the bottom of the test tube shows what sort of material left there? Judging by this experiment, we may say mortar is made of what substance?

How did our grandfathers make mortar? Their answer would be : "We slacked some quicklime and then mixed it with some sand. Such a mixture we called mortar." Our chemist will show us how to slack the lime. He takes a large lump of quicklime and pours some water over it. What happens to the lump, and what do you notice passing off? How does the vessel it is in feel to your touch?

"Slacked lime has been formed," says our chemist. Can you tell what the two substances are that united to form it? Now our grandfathers did not stop with this powdery material, but added water until they had made a smooth, pasty mass. If we follow their example, what shall we add to this pasty mass to make mortar of it? "Here are two pieces of brick," says our leader. "Where shall we put our mortar to make use of it?"

But we found carbon dioxide coming from that sample of old mortar in our first experiment. Where did it come from? "Here are two Mason fruit jars," we are told. "This one, by testing with some lime water at the end of this glass rod, has carbon dioxide in it; the other has only ordinary air. Into



Courtesy of University of Nebraska Alumni Association

This immense structure, seating 40,000 people, is almost one solid piece of Cement, Man-made Stone.

each of them we shall drop a piece of our mortar about as big as the end of your thumb. After screwing the lids upon them, we shall set them away for at least a week." At the end of the appointed time the pieces of mortar are taken out and each put into a test tube. Over each is poured some vinegar acid. Compare the amounts of gas given off by the relative "fizzing" of the two. Where did this carbon dioxide come from? Does the air about us contain carbon dioxide? Would the mortar between the bricks upon a building ever get carbon dioxide as did the mortar in the par of carbon dioxide? It is reported that pieces of mortar in the Roman walls two thousand years old have not even yet as much carbon dioxide as they could absorb. Why so slow?

What does the carbon dioxide do to the mortar when it makes it set? In this test tube is some lime water. By the aid of a glass tube the experimenter breathes through the water. What is the result? What does this show that our breath contains? Where does some of the carbon dioxide of the air come from?

"This milkiness," says our chemist, "is nothing more nor less than finely divided limestone. The combination of carbon dioxide with lime water make limestone. Lime water is of exactly the same composition as slicked lime. Then the setting of mortar is simply the combination of slacked lime with carbon dioxide, and it forms limestone. Thus we may say 'set mortar' is man-made stone."

In some parts of the world materials from which quicklime is made are not so plentiful as another substance, also containing calcium, known as gypsum. From gypsum is obtained the essential part of aonther man-made stone which we wish to study. First, we shall find out what, other than calcium, there is in gypsum. In this test tube is half a teaspoonful of gypsum. The lower end of the tube is heated, and during the process we shall notice the upper end of the tube carefully. What is noted? Rub a finger over it. Is it wet? "If we heat it just the proper amount," says the chemist, "we shall have a powder that contains only one-fourth of the water that a given sample of gypsum contains. This is called plaster-of-paris."

What happens when water is added to plaster-of-paris? Using a match-box for a "form," water is poured in first, the plaster-of-paris is then sprinkled in until some of the dry powder remains upon the surface unabsorbed by the water. Stick your lead pencil down into the middle of the soft material and leave it for thirty minutes. Now lift it out. Can it be done? Tear the match-box "form" away. Try to hammer with this stone hammer. Is this another man-made stone? The "form" helped us to "cast" this hammer. How does the doctor make use of plaster-of-paris? Does the sculptor ever use it? If so, how?

"These simple experiments," says our chemist, "show us two ways in which man makes stone. First, by allowing carbon dioxide of the air to combine with slacked lime, in mortar, to form limestone. Second, by restoring water, that has been driven from gypsum by heating it to the proper degree, to the almost waterless powder known as plaster-of-paris. A third kind of man-made stone, cement, is rather too difficult for us to undertake to study at this time."

The Care of Bees in the Schoolroom or Home

T. P. Webster, West High School, Akron, Ohio.

The interest which is spreading over the country relative to bee-keeping has in a manner contributed to the popularity of the observatory hive as a school project. This interest will prove not merely to be a fad, but will continue to develop as long as the industry of honey production continues to show such gains as have been witnessed in the last few years.

The colony of bees in the schoolroom or home is not only a source of pleasure, but offers a splendid opportunity to study at first hand some of the wonders of nature. Not only can we here watch the bees pick up the tiny particles of wax which have just been secreted, and build up the fine white comb which many people think is too perfect to have been made by anything but a machine, but all the wonders of parthenogenesis, metamorphoses, cocoon spinning, etc., can be seen as well.

Aside from the interest we have in these things as wonders of nature, there is an economic aspect which makes a study of bees worth while. The volume of honey annually produced in this country is much greater than many people realize. In the United States there are sixty million honey boxes made yearly. These boxes hold slightly less than a pound; so it is fair to assume that the actual yearly output of comb honey in the United States is somewhere around fifty million pounds. At the same time that the above statistics were gleaned it was known that three times as much extracted honey was produced as comb, but at the present time it would be conservative to say that there is at least five times as much. If the multiple of three is used, the total amount of extracted honey produced would be one hundred fifty million pounds.

Extracted honey sells anywhere from ten to twelve cents a pound, and comb anywhere from fifteen to thirty cents a pound. But let us take the conservative figures of ten cents per pound for both comb and extracted honey. This would make twenty million dollars worth of honey that is annually produced in

this country. During the period of the Great War, when honey was twenty and twenty-five cents a pound in car lots, the value of honey would be nearer fifty millions. As the average mind cannot comprehend these figures, let these two hundred million pounds of honey be loaded into cars of thirty thousand pounds to a forty-foot car. Let all these cars be put together into one solid train, and there will be a train fifty miles long.

The question arises then, how many colonies of bees are there in the United States? The best authorities estimate the number of colonies at ten millions, and the number of beekeepers at one million. Any industry then as important as this one is, deserves some slight attention, even though it affered us opportunity for close observation.

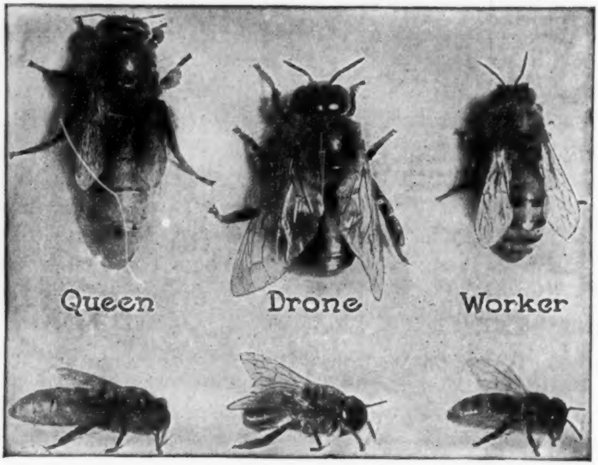


Fig. 1. The queen, drone, and worker bees.[1]

The origin of hives with windows or transparent slides is lost in the mists of antiquity. In very ancient times pieces of transparent substance, such as horn, isinglass, mica, etc., were fitted into the sides of the hives that the work of the bees might be observed. Such windows, however, offered but meager opportunity for studying the behavior of bees in the hive. The first approach to the modern type of observation hive was invented by W. Mew, of Easlington, Gloucestershire, Eng-

1 All cuts used in this article are used by courtesy of the A. I. Root Company.

land, about 1650. At about the same time, John Thorley, of Oxon, England, put bees in a bell glass and used bell glasses as surplus chambers on his hives. No practical advance was made from this until about 1730, when Reaunur, an eminent French naturalist, established a swarm between two panes of glass. This is the principle of the observation hive today.

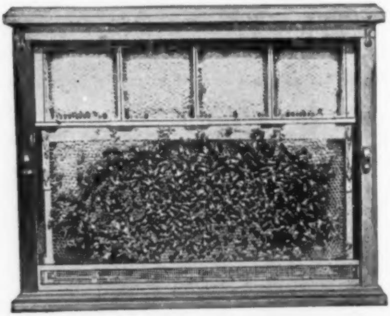


Fig. 2. Observatory hive.

This type of hive being the most widely used and advertised observatory hive, there is too often a decision made by the teacher to install only this type of hive. Manifestly it is only a temporary affair. It is highly improbable that such a small colony as this one frame could hive would be able to survive through a winter. The stock of bees would continually have to be replenished from some larger colony. For this reason it cannot be advised too strongly that a larger observatory hive be selected, if the most is to be gotten from a study of the bees. The eight-frame hive here shown is the type that has been used with success in one of the Akron high schools. Here it is possible for a colony of bees to carry on all the normal activities of a hive. Using this hive for observation as far as possible, and as a permanent source of stock for the one-frame hive, we have an ideal opportunity to study the bees. Here one can see carried out before his eyes the most interesting features of this wonderful community life. But it is important to remember that both types of hive are necessary. One of the most insistent demands will be to see the queen. This can be readily satisfied only with the one-frame hive. Another question will be as to whether these bees are making honey. There is very little likelihood that any surplus can be gotten

Fig. 3. The eight-frame hive.

from any hive smaller than the eight-frame hive. Unless these two features are satisfactorily shown, the project loses much of its effectiveness.

Having decided upon the type of hive, the next step is to go early in the spring to some local beekeeper and arrange for him to install a swarm of bees in your eight-frame observation hive, which has either been purchased from some supply house or made in the manual training department. It might be well to have him stock the one-frame hive as well, but you can do

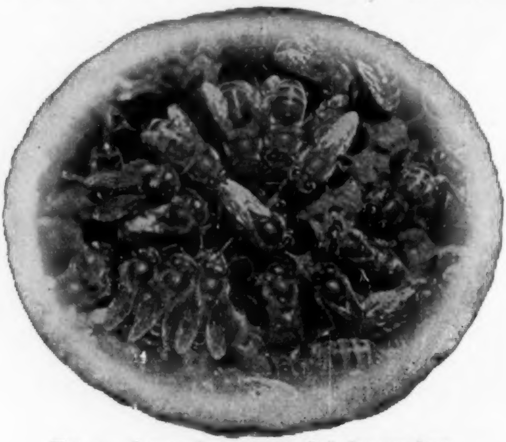


Fig. 4. Queen bee surrounded by workers.

that later yourself. All that is necessary to be done is to take a frame containing, in addition to adhering bees, eggs, larva in different stages, and sealed brood. This frame should then be inserted in the single-frame observatory hive. The section holders may then be let down in the same way. Under these conditions this small group of bees will likely set to work to rear a queen from one of the eggs or freshly hatched larva. They will build a little queen cell, having the appearance of a peanut, around the little larva, manufacture some royal jelly, and finally seal up the youngster with plenty of this food in the cell. They are likely to build more than one cell, but only one queen will be allowed to come to maturity.

After these bees have been imprisoned three or four days in this hive it will be well to set the hive up. If the bees are free to leave the one-frame hive soonr than this, they may desert

the hive and leave the brood to die. They should be placed next to a window on the south or east side of the building. It would be better if they were on the second floor, for then they would cause no disturbance on the school grounds. One must exercise great caution in these things, for one sting may give, not only the victim, but the project as well, a "black eye."

If there is no natural honey flow at the time these bees are installed, the bees in both hives ought to be abundantly supplied with stores. This can be done in the case of the one-frame hive by giving them pound sections of honey above the frame. The eight-frame colony can be fed by placing a syrup of two parts of sugar to one part water in this device, known as a Boardman feeder. This kindly treatment will have a tendency to make the bees contented in their new environment, because it gives them something to do. If this syrup is colored, one may see where it is deposited in the frames.

Fig. 5. The Boardman feeder.

And now the fun begins. The first time the children see a bee hovering around the entrance to the hive, they are afraid that it surely will get lost if it decides to fly two or three blocks away. They ask if it would not be the proper thing for them to pick some blossoms and carry them to the entrance of the hive for the bees. This interest has, in my experience, been an abiding interest on the part of many pupils. You are sure to find some boys who will immediately embark on the enterprise of beekeeping. It stimulates more interest on the part of parents than one would think. Many of them will come to the school to see the bees they have heard so much about. The industry of the bees seems to be a sort of stimulating example for both teacher and pupils, and soon the spirit of the hive has become contagious and the spirit of the school is quickened.

The bees can safely be left alone in the schoolhouse during the summer vacation. In most cities even, the eight-frame colony will store surplus honey. In a dry summer, when clover in the country is burned up, it will be flourishing in the sprinkled lawns of the city. It would be better to put on two supers instead of one, where the caretaker is going to be away for three months or more.

In the fall, in a locality where there are asters and goldenrod, one will have the stimulating pleasure of watching the feverish activity of the bees in preparation for winter.

For the best results in wintering the bees in the eight-frame hive should be taken outside after the killing frosts have come. It should be encased in a large box providing for six to eight inches of packing material, such as planer shavings, leaves or excelsior. A tunnel should connect the entrance to the hive with the outside. Here the bees, having a southern exposure if possible, should be left absolutely unmolested, if one is sure they have plenty of stores. If they do not, they should be fed liberally on going into winter quarters. In the spring, just before fruit bloom, they should be taken out of their winter quarters and again installed in the classroom. For the sake of a novel experiment the bees might be installed several feet away from the window with a long tunnel connecting with the outside. At the San Francisco Exposition in 1915 this was tried out and was a success.

These two hives will reveal the activities of the bees outside of the cells. When the bees come in with fresh loads of pollen or new honey, they show the usual signs of rejoicing by shaking their bodies, apparently to attract attention and thus induce other bees to find the treasures that they have brought home. A great many other interesting things can be discovered with one of these hives where the comb is parallel with the glass panel. But what transpires in the cells and behind the capping cannot be determined with this kind of glass hive.

If it is the desire of the student of bee life to see just what goes on in the cells, there is another type of hive called the Miller observatory hive. This ought not to be considered by anyone except one who has had experience with the two other types of hives. It took many years of patient toil and observation on the part of an expert to develop this hive.

As now made, it has a base about six inches wide and deep enough for a grooved feeder block to be slid into it under the floor of the hive, in the manner of a drawer. Access to this is obtained through several holes bored in the floor of the hive and guarded with excluder metal. A similar guard is adjusted to the hive entrance to prevent the loss of a swarm if the colony has to be left to itself for an extended period, for if thrifty it soon becomes overcrowded. This excluder metal prevents the queen from passing out of the hive and can easily be obtained from any dealer. The uprights are approximately three inches wide and grooved for four panes of glass, the inner panes being about one inch apart and the outer ones a quarter of an inch from the others. Panes fifteen inches long by ten inches wide have been found to be a very satisfactory size. The uprights are fastened to two horizontal pieces extending across the base. These latter pieces each have a groove one-half inch above the floor. Into these grooves are slid two strips of glass to close the space at the bottom betweeen each pair of panes. Between these strips and the raised sides of the base, strips of wire cloth are put and furnish the ventilating area. Galvanized wire cloth of fine mesh has proved preferable to ordinary painted wire cloth. The woodwork of the hive and the wire cloth is painted a dead black both inside and out. This gives a sharp contrast with the combs and is advantageous when taking photographs. The outside of the hive may be finished in natural wood, but the inside of uprights and under side of top should be dull black.

To stock this hive is somewhat troublesome. The two panes of one side of the hive are removed and the hive is laid on its side in a box prepared for this purpose, the tunnel of the hive connecting with an entrance in the side of the box. If this box arrangement is not used, trouble will be experienced by bees clustering on the outside of the ventilators. A sheet of new comb foundation has been given to a colony, and as soon as it has larva one to three days old it is ready for use. It is cut vertically into strips just a little narrower than the space between the inner panes. These strips are then laid in the hive, spacing them about an inch and a half from center to center. It is desirable that comb containing some honey be used also, and if there is not any honey in the upper part of

the brood comb, a strip or two of comb containing honey should be cut from some other comb.

If cells with the ends against the glass are also desired, a little more delicate work is necessary. To do this, take a new dry comb and cut a strip somewhat wider than needed, and then with a hot knife cut the cells from the base. These baseless cells are very delicate and must be cut to the required dimensions with a hot knife. They are then lifted on a cool knife or piece of cardboard and slid into position in the hive.

Next slide the other pair of panes into place. If any of the strips were cut too wide the glass will hit them and cause them to move. The entrance guard is lifted, a queen put in, and the guard replaced and the cover put on the box. On a wide board in front of the entrance shake the bees from two frames from some hive. The older bees will fly home, but the younger ones will crawl into the hive. They will go in better if the hive is dark. If they are a little slow to enter, they may be hurried by a gentle puff of smoke. This operation is accomplished better near the close of day, at a time when nectar is coming in from the fields.

The hive should be left in its horizontal position for a couple of days, so that the bees may firmly fasten the wax to the glass. If this is not accomplished in two days, one should look to see if the spaces between the combs are fairly well filled with bees. If not, more bees should be added. As soon as the combs are attached to the upper pane one may be sure that they are attached to the lower panes. Then the hive may be taken from the box and set in an upright position and removed.

After being set up where it is convenient for observation, the little colony, which has no field force, should be fed for several days. This will stimulate wax production and enable the bees to complete the comb. By coloring the syrup it is easy to see where it is placed first and moved afterwards. If feeding is necessary in cold months, hot syrup, one part water and two parts sugar, should be used. It will warm the hive and arouse the bees to come and take it. If it is very cold the hive may be closed and removed to a warm room, keeping it there till most of the syrup has been taken up. If the combs were packed with stores and the temperature keeps between

thirty-five degrees and sixty degrees Fahrenheit, the bees will not need feeding till spring.

If the hive becomes over-populous it should be removed at night to some other window, and in its place any convenient box containing a piece of comb with unsealed brood may be placed. The next morning the field force will start out as usual, but will return to the old location, where the brood will hold them. As soon as the population of the observatory hive is reduced enough, its entrance should be closed to prevent the escape of more bees. Within two or three hours the box on the old location may be taken away and the hive put back and the entrance opened. The removed bees may be destroyed or kept confined for a few days and then at nightfall be dumped into some hive in the apiary.

If the colony becomes weak it is easily strengthened by turning in a lot of young bees. An easy way to do this is to shake into a box, from some hive, all the bees adhering to a frame, and cover the box with a piece of wire cloth. Carry it to the observatory hive and fix it so the edge of the box is close to the opening. Remove the wire cloth and the bees will soon enter the hive.

This same manner of weakening or strengthening may be followed with the one-frame observation hive mentioned above, but it is easier in this case to remove the comb and bees and restock the hive completely.

This type of observation hive is good for about two years without renewing the comb, but by that time the comb becomes dark and the glass more or less coated with propolis, etc.

Bees winter nicely in these little hives with their double walls, provided the temperature does not stay below forty degrees Fahrenheit very long. A room temperature up to sixty-five or seventy does not cause trouble in winter, provided the entrance is wide open. A window facing the south is best for winter.

These small types of hives should have the ventilating space solely at the bottom of the sides or ends, and with double glasses with a confined air space between them. Extra space into which the bees may spread and yet not build comb is greatly to be desired, particularly in single-comb hives. This and ideal ventilating conditions are secured by having the floor wider than the hive and having such extension covered with wire

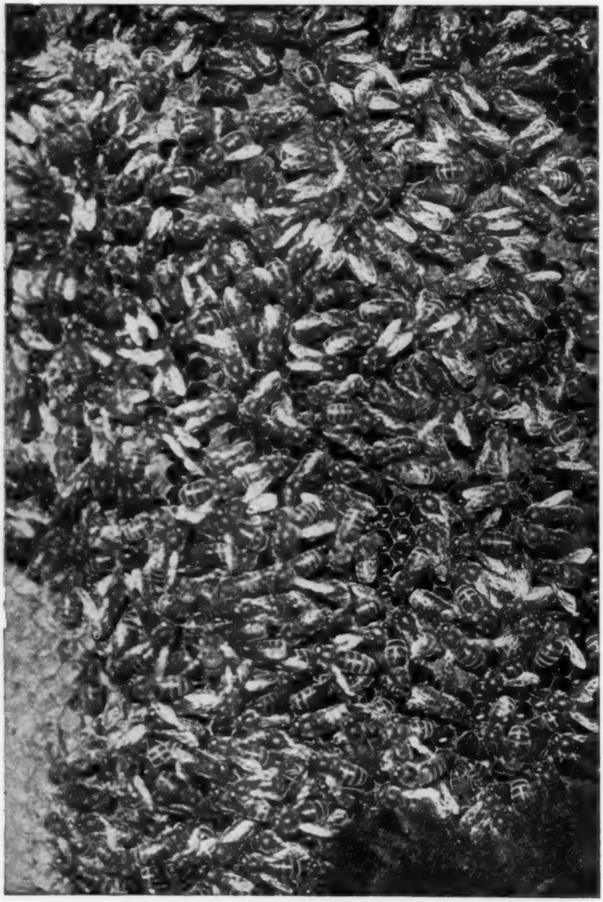


Fig. 6. Bees at work.

in units of time. In summer she works harder, consequently accomplishes her task sooner and so dies sooner. This bee, cloth. This last type of hive has been included in this discussion simply to make it complete. As one can readily see, it is only for the most advanced type of work.

Aside from the gains to be had by simply observing the bees, there are many ways in which these observations may be applied to our own lives. Unselfishness stands out as one of the prominent traits of the bee. A bee lives in units of work and not

working so hard in June that her life may in its entirety be only four or five weeks, of necessity must store her sweets for another yet unborn. Even in dying, the last effort of the bee is to aid the colony by dragging herself outside of the hive to die One of these dying bees, when picked up and put back on the alighting board, time after time will crawl away from the hive because she knows she is dying and consequently is of no further use to the colony. It is always for the good of the colony that the individuals strive. Even an aged queen lays the egg from which a young queen is reared to take the failing mother's place.

In the admirable division of labor we see a remarkable adaptation to the needs of the colony. We will say that upon a certain day three sorts of supplies are needed and available in certain quantities. It may be that water is easily obtained and that nectar is the harder to get. There is never a riot as to who will take the easy job. There is no grumbling about who gets the hard job. The hive is never overrun with one kind of material. There are no strikes, no lockouts, not even unions or an eight-hour day. These and many other lessons can be learned by observation.

Any surplus that is stored by the bees can be very readily disposed of at a fancy price. In a school where abundant funds are not available, this money can be used for the purchase of books or anything else needed by the classes. This feature of the project makes it an ideal one. Any tacher who tries this project will be surprised at the help it is in the teaching of biology.

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Methanol

NATIONAL WOOD CHEMICAL ASSOCIATION.

METHYL ALCOHOL, or methyl hydroxide, which is commonly known as wood alcohol, is a clear, colorless and poisonous liquid obtained by the distillation of hardwoods. In its crude state it is readily identified by a heavy, pungent odor; but, when refined for commercial use, this odor is almost wholly eliminated. Enough odor remains, however, to distinguish it from ethyl (grain) alcohol.

Classified as one of the "key" chemicals it is used in the manufacture of formaldehyde and its derivatives, dyes containing methyl groups, photographic films, celluloid, as a solvent for gums and shellacs, for denaturing grain alcohol, and various other industrial purposes of world-wide importance.

Wood alcohol when ingested in any of its grades and in any solution, is dangerously poisonous, menacing both life and eyesight, and should never be used internally nor as an adulterant or substitute for grain alcohol. However, there is no conclusive evidence that its external application or ordinary exposure to its vapors is injurious. Indeed, cases of poisoning among workmen in wood distillation plants are almost unknown.

When taken internally, the symptoms of acute poisoning are disturbances of the stomach, more or less severe, accompanied by abdominal pain, general weakness, nausea, vomiting, dizziness, headache, dilated pupils and blindness. If recovery does not occur, there is a marked depression of the heart's action, sighing, respiration, cold sweats, delirium, coma and death. The diagnosis can hardly be mistaken. Methyl alcohol poisoning presents a picture unlike that of any other intoxication. Acute abdominal distress followed by blindness should always awaken suspicion of wood alcohol poisoning.

On account of the large number of casualties attributed to drinking liquor containing wood alcohol, the importance of surrounding its use with every precaution to protect human life has attracted attention for many years, and as a result numerous protective and restrictive measures have been adopted. One of these measures is the proposal to discontinue from usage the name "wood alcohol" and use the scientific term *methanol.*

The term "methanol" came into scientific or chemical usage as a result of the action of the International Conference of Chemical Nomenclature which met in Geneva, Switzerland, in April, 1892. One of the resolutions adopted at this conference was as follows:

"The alcohols and phenols will be called after the name of the hydrocarbons from which they are derived, terminating with the suffix *ol;* as for example, methanol, ethanol, etc."

Following this conference, the term methanol found its way into German textbooks. Although the report of the Geneva conference was published in 1893, the term methanol did not come into favor in the American chemical profession until 1920. In that year the late Dr. Charles Baskerville published several articles wherein he advocated general adoption by chemists of the correct scientific term methanol.[1]

In his report as Chairman of the Nomenclature, Spelling and Pronunciation Committee of the American Chemical Society, Dr. E. J. Crane made the following statement in 1922 (J. Am. Chem. Soc., 44, No. 7, 78):

THE NAME FOR CH^3OH

"Some time ago the Occupational Diseases in Chemical Trades Committee of the American Chemical Society started a movement for the elimination from usage, in so far as possible, of names for CH^3OH containing the word 'alcohol.' The Nomenclature Committee co-operated to the extent of giving consideration to this subject purely from the nomenclature standpoint. While 'methyl alcohol' is not disapproved as a name, the name 'methanol' (Geneva nomenclature), which has grown in use as a result of this movement, is regarded as good usage. Methyl hydroxide, but little used, is not favored."

The term methanol is found in the "New Standard Dictionary" page 1564, as the chemical name for wood alcohol. It is also used in the "Chemical Engineering Catalog" (7th edition), and in "Chemical Abstracts," "Journal of Industrial and Engineering Chemistry," and "Chemical and Metallurgical Engineering." Many trade journals use the word methanol in

1 See "Wood Alcohol No Longer; Hereafter Methanol," J. Ind. Eng. Chem., 12 (1920), 910; and "Some Chemical Aspects of the Wood Alcohol Problem," N. Y. Med. J., 111 (1920), 580.

their lists of prices current as well as in all articles, notes and annual indices.

In the February, 1923, issue of the Journal of Industrial and Engineering Chemistry, (15, No. 2, 113), the following editorial appears:

THE IMPORTANCE OF A NAME.

"Perhaps one of the most important contributions of the American Chemical Society to the nomenclature has been the word 'methanol,' coined, we believe, by one of our committees to which the late Dr. Baskerville devoted much of his thought and effort. The term has been accepted by many of the large manufacturers, the Forest Products Laboratory, the Tariff Commission, and scientists generally.

"The National Wood Chemical Association has just adopted this term, and the following paragraph is quoted from its announcement:

" 'Our Association has given the matter due consideration and at a recent meeting of the Board of Governors adopted a resolution recommending that the term "Wood Alcohol" be discontinued and the term "crude methanol" or "refined methanol" be used hereafter as the case might be. Railroad companies will be requested to make such changes in their classifications and tariffs as they may consider necessary to apply the same rates on shipments of "methanol" as are now published on shipments of wood alcohol, and your co-operation in effecting this change will do much towards accomplishing the desired result.' "

"There is much work to be done in the revision of the nomenclature of any science, and a great part of it has to do with simplification and exactitude. It is, therefore, highly gratifying when we are able to contribute a word, the importance of which can actually be measured in terms of the saving of human life."

The subject is of such universal importance that the suggestion is made that all interested persons co-operate in the effort to establish the name *methanol* for the better protection of those who are not educated along chemical lines.

The Science Offering in the Private Schools of Massachusetts

Pauline Watkins, Cambridge Haskell School,
Cambridge, Massachusetts.

This investigation was made for the purpose of determining the science offering in the private schools of Massachusetts. This particular state was chosen because of previous knowledge obtained from personal experience in Massachusetts private schools and because there are in this state a large number of high class schools.

To ascertain the offering in science, a letter and questionnaire were sent to 60 representative private schools. These were 23 boys' schools ranging in size from 60 to 528 pupils, 21 girls' schools ranging in size from 25 to 577 pupils, 16 coeducational schools ranging in size from 40 to 295 pupils. Fifty answers were received and eight helpful letters giving more details than the questionnaire called for. Forty-seven of the replies were usable. The author acknowledges indebtedness to those who assisted in this investigation.

The most significant results of the investigation are briefly summarized in the following tables. The schools reporting, differed markedly from each other in the number of grades offered. The differences ranged from schools offering only three grades to those offering twelve grades. This study was made in connection with course work in Teachers College, Columbia University.

In the 47 schools reporting, 18 different groups of grades were found: 21 per cent include the last four years' work in the secondary school, 19 per cent include the grades found in the public junior and senior high schools, 12.7 per cent include the twelve grades, 8.5 per cent include the last five grades.

Twelve science subjects are taught in the 47 private schools. The relative prominence was determined by the total number of classes in each science in all schools, shown by Table I.

TABLE I.

THE RANKING OF SCIENCE SUBJECTS BY CLASSES.

Science	*No. of Classes*	*Science*	*No. of Classes*
1. Nature Study	80	7. Botany	10
2. General Science	45	8. Zoology	9
3. Physics	45	9. Physical Geography (in High School	6
4. Chemistry	39	10. Astronomy	3
5. Physiology	22	11. Geology	3
6. Biology	21	12. Agriculture	2

It will be noted that nature study receives the greatest recognition with 80 classes, while physical geography, astronomy, geology and agriculture have small recognition.

Fourteen of the schools reporting offer a course in science in every grade included in the school. These courses appear to be arranged in a sequential order, starting with either nature study or general science, followed by courses in the specialized sciences.

Thirty-one of the 50 schools have one or more special teachers for science; four schools have a special teacher for science and mathematics.

Of the 319 science courses, 69.3 per cent are required of all students in the grades to which they are offered. All courses in the first six grades are required. Nature study is, in each case, offered as the required subject. In general science 40 of the 43 courses are required. Physics and chemistry are commonly offered as electives only about one-third of such offerings being indicated as required. Nearly 80 per cent of the courses in the biological sciences are required.

Table II, showing the percentage of classes taking each science, gives an approximate idea of the grade placement of the sciences and the science sequence found in the private schools of Massachusetts.

TABLE II.

NUMBER OF SCHOOLS OFFERING EACH GRADE AND PER CENT OF SCHOOLS OFFERING EACH OF THE SCIENCES.

Grade	1	2	3	4	5	6	7	8	9	10	11	12	13
Total Science Classes	12	12	14	16	18	21	30	33	43	40	38	38	2
Nature Study	75	83	85	75	66	57	26	15					
General Science				12.5	16.2	14.2	20.0	33.3	34.9	17.5	5.2	2.6	
Physical Geography						30.0	9.9	4.6	7.5	2.6	2.6		
Physiology								18.6	12.5	10.4	5.2		
Botany								4.6	10.0	2.6	7.8		
Zoology								9.2	2.5	5.2	5.2		
Biology								9.3	12.5	15.7	7.8		
Physics									7.5	44.7	63.1		100
Chemistry								6.0	2.5	26.3	63.1		100
Total	75	83.3	85.5	87.5	82.2	71.2	70.0	60.6	60.4	55.0	81.0	94.7	100

Table should be read: 75 per cent of the 12 first grade classes offer nature study.

The column of totals shows the per cent of all schools offering some science in each grade indicated. For example, there were 43 schools offering ninth grade work. Some science was offered to the ninth grade in 60 per cent of these schools.

Table II shows a definite placement of nature study in the first six grades and of general science in the seventh, eighth and ninth grades. The placement of the biological sciences is less definite. The tendency is to place them in the ninth and tenth grades. Physics is definitely placed in the eleventh grade, and physics and chemistry in the twelfth grade.

Summer Courses in Science

Columbia University, New York City. 6 *weeks.*
- Principles and organizations of science in secondary schools. Professor O. W. Caldwell.
- The teaching of general science in secondary schools. E. R. Glenn.
- Teaching of biology in secondary schools. C. W. Finley.
- The teaching of physics in secondary schools. E. R. Glenn.
- The teaching of chemistry in secondary schools. A. I. Lockhart.
- Special problems in science teaching. S. R. Powers.

Cornell University, Ithaca, New York. 6 *weeks.*
- General nature study. Anna B. Comstock, Charles Beaman, John L. Buys.
- Nature literature. Anna B. Comstock.
- Science in the rural secondary schools. Charles Beaman.
- Teaching of chemistry in secondary schools. A. E. McKinney.
- Teaching of physics in secondary schools. C. E. Powers.

Hampton Institute, Hampton, Virginia. 6 *weeks.*
- The teaching of general science. W. G. Whitman.
- The teaching of high school physics. W. G. Whitman.

Indiana University, Bloomington, Indiana. 8½ *weeks.*
- Life views of great men of science. T. E. Nicholson.
- The teaching of chemistry. F. C. Mathers.
- The teaching of botany. Charles Weatherwax.

*University of Chicago, Chicago, Illinois...*6 *weeks or* 12 *weeks.*
- Nature study. Mr. Frank.
- The teaching of general science.
- Biology in secondary schools. Professor Downing.
- The teaching of high school physics. Mr. Lohr.

University of Pennsylvania, Philadelphia, Pennsylvania. 6 *weeks.*
- Principles of teaching general science. Dr. Wildman.
- Content course in general science. Dr. Wildman.

A Forest Buried Under the City of Washington

Evidence of the existence of an ancient swamp in which great trees flourished in days long past, possibly contemporaneous with earliest man in Aemrica, has just been discovered in a deep excavation made for the foundation of a hotel under construction in Washington, D. C. At a depth of about 25 feet below the street level the excavation disclosed a layer of black swamp muck, containing large quantities of wood, tree trunks, and stumps. Some of the stumps are of great size, a few of them reaching a diameter of 9 or 10 feet. Much of the wood is well preserved, showing clearly the woody structure and the external markings of the bark. A preliminary examination indicates that one of the more common trees of this ancient swamp was cypress.

The story of these trees, however, is only a brief chapter of the whole geological history shown in the excavation. which has just been examined by Chester K. Wentworth for the United States Geological Survey. Ages ago this part of the Atlantic Coastal Plain was from time to time covered by the sea, into which streams swept vast quantities of mud, sand, and gravel and boulders which formed thick deposits that covered large areas. When the region finally emerged from the sea the Potomac River cut its valley in these deposits, which were carried about here and there also by smaller streams. The larger boulders are derived from the granite on which the gravel lies, but some of the smaller pebbles come from parts of the Potomas basin beyond the Blue Ridge, and others from veins of quartz in the granites of the Piedmont plateau.

Over the layer of plant debris and muck in this old swamp, fine clay and pebbles were laid down by streams of water during the glacial epoch, when the northern part of North America, as far south as northern Pennsylvania, was covered with immense sheets of thick ice, showing that the trees lived in the latter part of the Great Ice Age, which is variously estimated to have ended from 20, 000 to 30,000 years ago.

The Multiplication of Bath Tubs

Homer, writing nearly a thousand years before Christ, of the Trojan War, four hundred years earlier, mentions polished marble bathtubs. Cordova, capital of the Moorish empire of Spain, had 900 public baths in the eleventh century. But the first bathtub in the United States was imported from England about 1820, and the first one built in this country was made in Cincinnati in 1842, of mahogany lined with sheet lead.

Eli Whitney, inventor of the cotton gin, imported the English tub, and was so proud of it that he kept it outside his home in New York City, alongside the front steps, says a writer in the Philadelphia *Public Ledger,* and had it carried in when he wanted to use it. After the Cincinnati tub was built by Adam Thompson, others were constructed. One was put in the White House in 1851, to the delight of President Fillmore. That was a great advertisement for the new convenience, but opposition to it arose from a surprising source. The medical profession was bitterly against it, as endangering health. Its influence suggested legislation forbidding it as a public menace. The common council of Philadelphia, in 1853, rejected prohibition of the use of bathtubs between November 1 and March 15, by only two votes. Virginia's legislation put a tax of $30 on each tub, and in 1845 Boston's council forbade the use of a bathtub without a medical order.

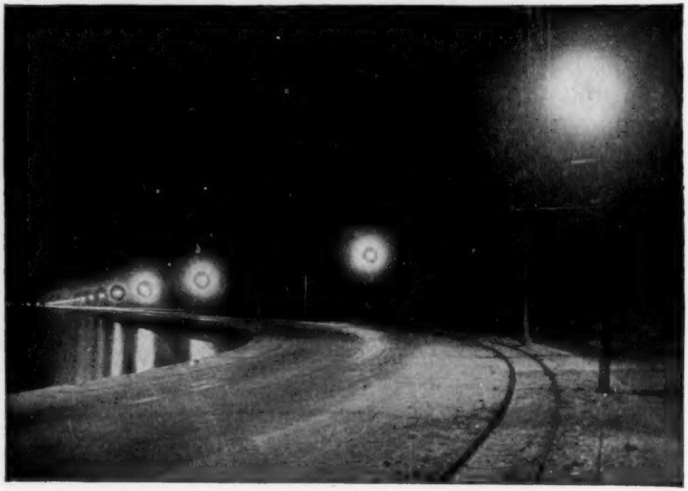
Those things happened when the prevailing belief was that it was dangerous to health to bathe in cold weather,—a belief strengthened by the attitude of physicians and one which persisted well along into the 80s in many cities, and which may be found on intimate inquiry to still exist here and there. Now, it is said, there are two bathtubs to every automobile in the country. There were many decades in the last century in which it was regarded as highly hazardous to bathe the body in warm or hot water during the season of frost, and, no doubt it was indiscreet to do it in a cold room. But not before the kitchen stove!—*The Valve World.*

The Novalux Highway Lighting Unit

By R. E. Greiner, Edison Lamp Works,
Harrison, N. J.

The increasing number of night accidents and holdups along interurban highways has been for several years emphasizing the need for providing an improved method of highway lighting and of extending it to the many miles of congested roads now unlighted.

It is generally agreed that automobile headlights alone do not provide illumination of sufficient intensity and diffusing quality to meet the requirements of highway lighting where traffic is dense. Nor do the present systems of highway lighting furnish light enough to enable the driver to distinguish obstacles and prevent collisions.

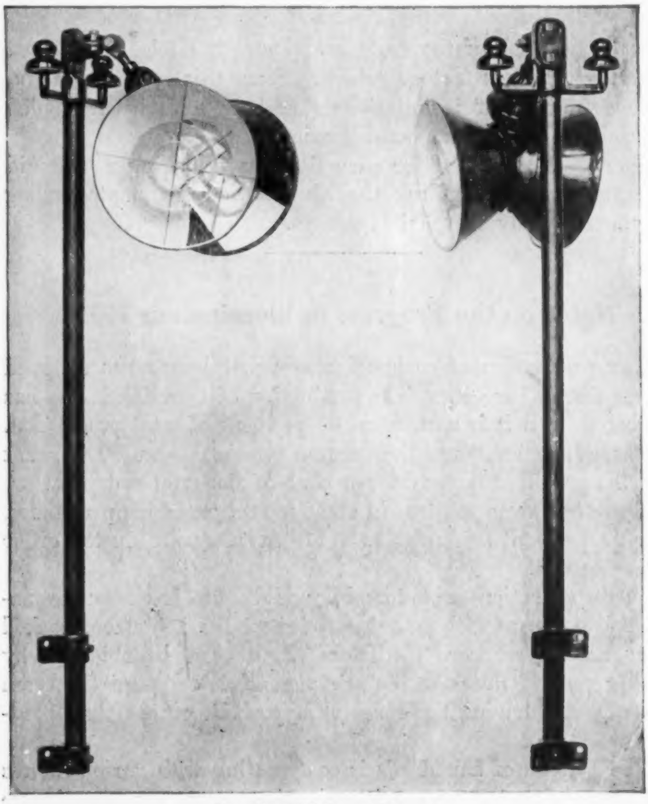


Night view of Novalux Highway Lighting installation, Miami, Florida.

It is evident that a lighting system for this purpose must be of as low a cost as possible and yet effective. After considerable experimentation the Lynn engineers have designed a unit which seems to meet these severe requirements. This unit, which is marketed by the G-E Supply Department under

the name of the "Novalux Highway Lighting Unit," has proven by demonstration and test to be very much superior to any other equipment so far produced.

This fixture, which is designed especially for use with a 250-candle-power series Mazda C lamp, consists essentially of three pairs of porcelain enameled steel parabolic reflectors, so arranged as to produce a ribbon of light along the roadway, conserving the light which ordinarily would be dissipated upward or beyond the roadway. The units are usually arranged for mounting on poles along the roadside, with an adjustment



Novalux Highway Lamps.

to take care of the ordinary variations in the position of poles or road curvature. A modification of this type for overhead suspension is also available.

Extensive demonstrations and observations in Swampscott, Mass., and near Schnectady, N. Y., have shown that with a spacing of 300 feet a very satisfactory driving light is secured, rather better than is found in most residence streets in cities. Spacings as high as 600 feet have been tested, but gave less effective illumination, even when used with a correspondingly higher-powered lamp. A hanging height of at least 35 feet is recommended for assuring good distribution and avoiding glare.

An installation of the units near Detroit, Mich., is reported as giving very satisfactory results. Since this system went in, quite a number of installations elsewhere have been decided upon or are now under consideration.

There is a real need for such lighting, affording a splendid opportunity for extending the illumination so adapted along the more heavily traveled highways.

Notes on the Progress in Illumination 1923

THE production of carbon incandescent lamps has dropped to less than 1 per cent. The production of tungsten lamps has increased until it is more than 99 per cent of total production. Of these tungsten lamps the vacuum type makes up 80 per cent and the gas-filled lamps 20 per cent of the total number.

There has been progress in standardization of lamp voltages, over 91 per cent being for 115, 110 or 120 volts, in the order of preference.

Directive action in automobile headlights has been accomplished by means of glass lenses with modified surfaces backed by parabolic reflectors. These results can be obtained by having vertical flutes in the mirror surface to spead the beam laterally and having the reflector hyperbolic rather than parabolic.

The Bureau of Standards is co-operating with various states in determining the proper illumination for automobile license plates. The work is not yet completed.

A new carbon arc for moving pictures has both carbons horizontal. The crater of the positive carbon faces a convex mirror, through the center of which passes the metal-coated negative carbon. Rays from the positive are sent back from the reflector through the projector aperture, giving an even screen illumination.

The first aerial lighthouse in this country has been put in operation at College Point, Long Island. The light source is a 14-inch navy type searchlight of 600,000,000 candle power. The beam of light will swing slowly around on a tower mounting and will be visible at a distance of 50 miles.

The cross-country postal service necessitates a series of these lights stretching across the country. That part of the route covered by night—Chicago to San Francisco—will have a continuously lighted highway. The most powerful lights will be in Chicago, Iowa City, Omaha, North Platte and Cheyenne. Smaller lights of thirty miles range will be placed between the larger units, and flashing traffic lights directed upward will be located every three miles.

Tests made to show the effect of increased lighting upon production in industry work have shown the following: in nine different industries an average increase from 2.3 foot candles to 11.2 foot candles gave a production increase of 15 per cent.

About 15,000 electric lamps are used to light the 4,000 rooms of the Leviathan.

The melting point of tungsten has been determined as 3370° C. ± 50°.

The phosphorescence resulting when lumps of sugar are broken is called triboluminescence. It was thought that this light had a continuous spectrum, but recent experiments show that it is discontinuous, and that the bands belong to nitrogen alone. When lumps of sugar in a glass jar having a pressure of 4 to 0.1 cm. of mercury are shaken against the walls to break them, much more intense triboluminescence results.

Rapid photographic plates exposed for one and one-half hours at a depth of 3,300 feet in the ocean show evidences that light reaches that depth. Plates exposed at a mile depth gave no indication of the presence of light. Experiments have shown that ultra-violet light for sterilization can penetrate but a comparatively limited distance even in clear water.

The New Books

Household Physics—W. G. Whitman—viii+435 pages—329 illustrations—$1.90—John Wiley and Sons.

This is a practical physics of everyday life which stresses the application of physics principles found in the home. Heat and light receive greater prominence than the other divisions of physics and yet a well balanced course is given. Theory is made subordinate to uses, but is brought in as explanatory material where it is needed for a better understanding of the subject. The chapter headings are: how heat is measured, how we make use of expansion, thermometers, practical ventilation, how heat travels, the weather, boiling water and steam, heat for cooking purposes, small heaters, heating the home with stoves and furnaces, hot water and steam heating, refrigeration, electric currents and magnets, electrical devices in the home, light a form of radiant energy, natural light, artificial light, illumination, optical devices in the home, the home water supply, machines of the home, the automobile, household measurements, sound, radio.

Some problems and questions are given, though the mathematical side of the subject is not greatly emphasized. The illustrations are in the main quite distinct from those in the usual physics text. The frontispiece is a valuable reference chart for colors and color values. Each chapter is followed by a summary. Suggestions for further study by projects and laboratory exercises, and a bibliography of references are given.

How We Are Sheltered—J. F. Chamberlain—156 pages—illustrated—The Macmillan Company.

This is the third in the series of Geographical Readers. Typical shelters in different countries are contrasted with those of our own country. Building materials are well treated and the great need of conservation by an extravagant people is emphasized. The illustrations are excellent and add much to the attractively written volume.

How We Travel—J. F. Chamberlain—182 pages—illustrated—The Macmillan Company.

"How We Travel" is the fourth and last of the series of Geographical Readers by the same author. It gives accounts of modes of travel in different lands, but treats especially of transportation in the United States from colonial days to the present. In addition to travel, communication is taken up in six of the chapters which cover mail, telegraph, telephone, cable and wireless. In this whole series we find more than readers, they are texts, and at each chapter end, questions are given on the chapter and suggestions for map study of further study. The four books in the series cover the four units upon which introductory geography work should be focussed.

How to Teach Physics—Rogers D. Rusk—186 pages—$1.80—J. B. Lippincott Company.

Every progressive science teacher is constantly striving to improve his method of teaching. Teaching helps are far too few. "How to Teach Physics" is a timely teachers' text. It has safe and sane advice, both for the inexperienced and for the experienced teacher. It has also many specific suggestions on subject matter, as well as on teaching methods.

The following topics are discussed at length: physics and modern education, the development of physics as a subject, the development of physics teaching, the aims of physics, the meaning of physics, physics and mathematics, scientific method, practical physics teaching, classroom material and organization, the laboratory course, vitalizing the physics course, apparatus and equipment, some common mistakes, grades and tests in physics.

Louis Pasteur—S. J. Holmes—246 pages—14 illustrations—Harcourt, Brace and Co.

This is a short story of the life and work of Pasteur, for the student and general reader. The book traces, in simple and clear language, the whole course of those experiments and discoveries of Pasteur that so conclusively proved the *germ theory* of disease. You will find here an interesting account of those factors which molded Pasteur's life and character and started him upon the life work which made him one of the world's greatest benefactors. It is an admirable book for the General Science reference shelf.

Elements of General Science—Otis W. Caldwell and William L. Eikenberry—455 pages—223 illustrations—$1.60—Ginn and Co.

This is a revision of the author's popular text, brought out some ten years ago. The general divisions of subject matter are practically the same as in former editions, but new material has been added, particularly relating to health, engines and radio. It aims to present a "broad, unified picture of science as a whole," and covers these main divisions: the air; water and its uses; work, energy and electricity; the earth in relation to other astronomical bodies; the earth's surface; life upon the earth. A striking colored frontispiece, "How the fathers traveled," attracts one at the start. The questions at the beginnings of chapters arouse interest which is carried over to the study of the text. Both users of the older books and others will welcome this revised edition.

The New Qualitative Analysis—F. H. Currens—50 pages—Paper covers—65 cents—Miner Publishing Company, Nacomb, Illinois.

The purpose of this work is to present a brief course in qualitative analysis which can be used in a one-year course of general chemistry. Concise directions for regular analysis are given. Teachers who wish to give a brief but useful survey of qualitative analysis will find help in this book.

Modern Mathematics; Seventh school year—Raleigh Schorling and John R. Clark—256 pages—88 cents—World Book Company.

This is one of a series of books which marks a forward step in the teaching of elementary mathematics. "This text is planned to develop more than usual skill in computation by limiting the practice material to a degree of difficulty and complexity that is required in ordinary life." The introduction of each new set of exercises by a "human interest" situation creates an atmosphere of worth-whileness that the pupil grasps, and does much to make willing workers. Everyday projects are worked out to challenge thought. The general science idea applied to mathematics disrupts the old-time special divisions of mathematics, and materials needed for the solution of the pupil's problem may be used notwithstanding its source. Many review, accuracy, speed, and skill tests are used.

Modern Mathematics; Eighth school year—Raleigh Schorling and John R. Clark—254 pages—88 cents—World Book Company.

This book is worked out on the same general plan as the seventh grade book and the practical character of the material is indicated by the chapter titles: how to solve problems, how to express relations between numbers, how to use equations, practical measurements, how to find unknown distances by scale drawings, using the right triangle, important principles of arithmetic, paying for the use of money, the secret of thrift, making money earn money, the nature of insurance, why people pay taxes, the use of positive and negative numbers. The book must be examined to be fully appreciated. It is a superior work and in a class by itself because of its personal and practical appeal.

Modern Algebra; Ninth school year—Raleigh Schorling and John R. Clark—382 pages—$1.36—World Book Company.

Modern algebra is "general mathematics" with the greater emphasis upon the algebraic processes. Arithmethic, algebra, geometry and trigonometry have escaped their usual bounds and mingle here in co-operation to solve simple everyday mathematical problems. The introduction to new topics is so interestingly done that the pupil finds himself in the midst of solving rather difficult problems without realizing any difficulty. In spite of the popular treatment, the book fulfills the college entrance requirements for a year of algebra. The three texts in this series are good examples of the application of modern psychology in the preparation of practical text books.

Smith's Intermediate Chemistry—J. Kendall and E. E. Slosson—566 pages—140 illustrations—The Century Company.

Every science teacher wants an authorative work on chemistry. This volume satisfies this want. For purely chemical facts and for chemical theory this volume cannot be excelled. It does not run to everyday applications of science as much as many other texts do, but it does cover the chemistry of inorganic substances very completely. In the place of a preface an answer is given to the question, "Why study chemistry?" There are fifteen full page half-tones of famous chemists and of chemistry at work.

Teaching First Year Chemistry—J. O. Frank—64 pages—$1.00—Published by author at Oshkosh, Wisconsin.

This bulletin is divided into three parts: I. General chemistry; II. Qualitative analysis; III. Special aids in teaching chemistry. Part I treats of aims, types of courses, texts and equipment, and includes an outline of a standard course in chemistry. The quiz and examination are discussed at some length. There are several pages of bibliography, formulas for making up liquid reagents, and other valuable information. It is a good book for the younger teachers, and for some of the older ones as well.

The Teaching of Arithmetic—N. J. Lennes—486 pages—The Macmillan Company.

The general problems bearing on the teaching of arithmetic are discussed in four chapters: Formal discipline, methods of learning and teaching, motivation in the early grades, and motivation in the grammar grades. Twenty-two chapters cover specific problems, as: Number combinations, common fractions, percentage, interest, banks, insurance, mensuration, etc. A chapter each is devoted to: Objects to be achieved in arithmetic, the text-book, and measuring the results of teaching. There is no question of the value of this book to a mathematics teacher, nor of its help to the prospective teacher of arithmetic.

Laboratory Studies in Mammalian Anatomy—Inez W. Wilder—157 pages—$2.00—P. Blakiston's Sons Co.

This book outlines elementary laboratory work in anatomy to accompany a course in human anatomy and physiology. Use is made of the human skeleton, manikins, and models of the human body. For dissection, the smaller mammals, rabbits, rats and guinea-pigs, and such parts of larger mammals as can be secured from abattoirs, are used. The amount of material is sufficient to allow certain gent living by giving a thorough knowledge of the relations of the options in a years' course. The course very well introduces one to zoology, but its greatest value lies in preparing the pupil for intelli-different systems making up the human machine.

Science Articles in Current Periodicals

ANT

The Argentine ant, the scourge of many cities. W. D. Pierce. Amer. City, 30,373. Apr., 1924.

ARCTIC EXPLORATION

Arctic exploration by aircraft. Ill. Sci. Amer., 130:152. Mar., 1924.

ASTRONOMY

Earth and moon. Ill. Isabel M. Lewis. Sci. and Inv., 11:1102. Mar., 1924.

ATOM

The magnificent complexity of the atom. Lit. Dig. 81:2:23. Apr. 12, 1924.

AUTOMOBILE

The engine as a brake. Sci. Amer. 130:178. Mar., 1924.

Parking—when, where and why. Miller McClintock. Amer. City, 30:360. Apr., 1924.

BIRDS

Bird architects and architecture. Ill. L. W. Brownell. Nature Mag. 3:197-204. Apr., 1924.

Interesting children in birds. Ill. A. M. Peterson. Nature Mag. 3:236. Apr., 1924.

CHEMISTRY

Chemistry as a crime-detector. Lit. Dig. 80:13:23. Mar. 29, 1924.

CHILDREN

Why children cheat and steal. Lit. Dig. 80:11:31. Mar. 15, 1924.

CHOCOLATE

The story of chocolate. Ill. Blanche Ingersoll. Amer. Food Jour. 19:76. Feb., 1924.

COTTON

From boll to bolt. Ill. J. S. Wanamaker. Nature Mag. 3:141-6. Mar., 1924.

ELECTRONS

Mystery ray as revealed by photos. Ill. W. D. Harkins. Pop. Mech. 41:494. Apr., 1924.

ENGINE POWER

More steam-engine power without steam. Ill. Ismar Ginsberg. Sci. Amer. 130:168. Mar., 1924.

FILTRATION PLANT

The new rapid filtration plant at Cambridge, Massachusetts. Ill. George A. Johnson. Amer. City, 30:241. Mar., 1924.

FLOWERS

"Prim" gladiolas, the flower of the family. Ill. Alice Rathbone. Garden Mag. 39:133. Apr., 1924.

FLOWERS

The family of flowers that really love the shade. Ill. Louise B. Wilder. Garden Mag. 39:136. Apr., 1924.

GELATINE

The gelatine you eat. A. J. Ingalls. Sci. Am. 130:170. Mar. 1924.

GEOLOGY

Autobiography of a rolling stone. William C. Alden. Nature Mag. 3:153. Mar., 1924.

HEALTH

How to plan a poster. Ill. John T. Lemos. Hygeia, 2:162. Mar., 1924.

The rules of the game. Jesse F. Williams. Hygeia, 2:142. Mar., 1924.

Pyorrhea. Ill. Arthur D. Black. Hygeia, 2:170. Mar., 1924.

Health-educating Detroit children. Ill. Ethel Perrin. Nation's Health, 6:177. Mar., 1924.
Public health activities in foreign lands. Ill. K. M. Olmstead. Nation's Health, 6:151. Mar., 1924.
The Philadelphia Child Health Society. W. C. Ewing. Child Health Mag. 5:118. Mar., 1924.
Winter sports serve to promote community health. Ill. Mabel T. Wood. Nation's Health, 6:77. Feb., 1924.

HOLT
L. Emmett Holt, a great teacher. Child Health, 5:42. Feb., 1924.

HOUSING PROJECTS
Open spaces and road frontages. Ill. F. L. Thompson. Am. City, 30:153. Feb., 1924.
Does beauty pay? Ill. E. F. Brown. Am. City, 30:165. Feb., 1924.

HYGIENE
The museum of hygiene. Ill. Child Health Mag. 5:161. Apr., 1924.

LIGHT
Daylight intensity at a window opening. Ill. Herbert H. Kimball. Ill. Trans. Ill. Eng. Soc., 19:217-234. Mar., 1924.
Daylight from windows. Ill. Higby and Younglove. Trans. Ill. Eng. Soc., 19:235-268. Mar., 1924.

LIGHTING
Colored lighting. Ill. M. Luckiesh and A. H. Taylor. Trans. Ill. Eng. Soc., 19:135-149. Feb., 1924.
Proper lighting an aid in preventing accidents. R. E. Simpson. Trans. Ill. Eng. Soc., 19:93. Jan., 1924.

LIGHTNING
Grounding lightning. Ill. D. O. McAllister. Prac. Elec. 3:234. Mar., 1924.

MACHINES
Simple levers. Ill. Pop. Mech. 41:459. Mar., 1924.

MALNUTRITION
Home-control, a factor in malnutrition. Herman Robins, M.D. Child Health Mag. 5:51. Feb., 1924.
The open-air class and malnutrition. Ill. Angie G. Reynolds. Child Health Mag. 5:71. Feb., 1924.

MECHANICAL POWERS
Friction: Wheel and axle. C. W. Mitman. Pop. Mech. 41:777. May, 1924.

MILK
Milk drinks and other milk products. A. L. Israel. Am. Food Journal, 19:65. Feb., 1924.

OIL
Teapot dome. Sci. Am., 130:224. Apr., 1924.
The nation's oil reserves. Ill. Stephen Bonsal. Rev. of Rev., 49:268. Mar., 1924.

PHOTOGRAPHY
Camera takes 2,000 photos a second. Ill. Pop. Mech. 41:348. Mar., 1924.

POTASH
Laying the ghost of a war-time trouble. Ill. Guy E. Mitchell. Sci. Am. 130:180. Mar., 1924.

PRESERVING FOOD
Fresh fruit for every day in the year. Pop. Mech. 41:558. Apr., 1924.

PSYCHIC RESEARCH
Thirty years of psychic research. J. Malcolm Bird. Sci. Am. 130:160. Mar., 1924.

RADIO
Lightning protection for antennae. Ill. J. R. McFarlin. Radio News, 5:1257. Mar., 1924.
Condensers. Ill. Jesse Marsten. Radio News, 5:1250. Mar., 1924.
Tuning and what it means. Ill. J. V. L. Hogan. Radio News, 5:1232. Mar., 1924.
Recent novelties in thermionic tubes. Ill. J. A. Fleming. Radio News, 5:1222. Mar., 1924.
Building a five-tube neutrodyne receiver. Ill. F. L. Brittin. Pop. Mech. 41:441. Mar., 1924.
Radio teelvision. Ill. Nicholas Langer. Radio News, 5:1570. May, 1924.
Improvements on the super-heterodyne receiver. Radio News, 5:1576. May, 1924.
The vacuum tube. Ill. John H. Morecroft. Radio News, 5:1582. May, 1924.
A training school for science. Lit. Dig. 80:11:22. Mar. 15, 1924.
Radio and the public address system. Ill. W. S. Thompson. Radio News, 5:1398. Apr., 1924.
Policing the air to protect radio fans. Pop. Mech. 41:759. May, 1924.
Radio telephone equipment for the air mail. Coml. Amer. 20:27. Apr., 1924.

RAILROADS
Railways' needs vital to the nation. Ill. C. H. Markham. Pop. Mech. 41:506. Apr., 1924.
Feats of railroading in the Andes. Ill. P. E. James. Pop. Mech. 41:539. Apr., 1924.

SANITATION
Preventive medicine and sanitation in relation to efficiency. Ill. Charles A. Kofoid. Nation's Health, 6:80. Feb., 1924.

STEEL
The story of steel. Ill. Sci. Amer. 130:162 and 224. Mar. and Apr., 1924.

TIRES
Balloon tires roll into favor. Ill. Coml. Amer. 20:31. Apr., 1924.

TORNADOES
Tornadoes—the funnel clouds. Ill. G. Pickwell. Nature Mag. 3:147. Mar., 1924.

TREES
What trees are best for town and city. Ill. R. L. Moulton. Pop. Mech. 41:419. Mar., 1924.

VOLCANOES
Volcanic lava beds in southern Idaho; among the "craters of the moon." Ill. R. W. Limbert. Nat. Geog. Mag. 45:303-328. Mar. 1924.
Sakurajima, Japan's greatest volcanic eruption. Ill. T. A. Jaggar. Nat. Geog. Mag. 45:441-470. Apr. 1924.

WATER
Why should water taste. John R. Baylis. Amer. City, 30:365. Apr., 1924.

WATER POWER
Harnessing Arkansas' water power. Ill. R. E. Livingstone. Sci. Amer. 130:174. Mar., 1924.

Magazine List

American City. 443 Fourth Ave., N. Y. C. Monthly. $4.00 a year, 50c a copy. The science problems of city and rural communities are treated in numerous articles, well illustrated. A valuable student and teacher reference.

The American Food Journal. 25 E. 26th St., New York City. Monthly. $3.00 a year, 25c a copy. Articles on food manufacture, food legislation, and experiments in nutrition.

Commercial America. Phila. Com'l Museum, Phila., Pa. $2.00 a year. Ill. Commercial production. New inventions. Will interest commercial geography and science teachers.

Current Opinion. 65 W. 36th St., N. Y.,Monthly. 35c a copy, $4.00 a year. Has a regular department "Science and Discovery," containing articles of popular interest, adapted to pupils or teachers.

The Educational Screen. 5200 Harper Avenue, Chicago. Monthly. 15c a copy, $1.00 a year. Discusses the use of movies in our schools; gives brief descriptions of educational films and lists theatrical films which are suitable for children. The journal is entirely educational, having no commercial affiliations.

Garden Magazine. Garden City, N. Y. Monthly. 25c a copy, $3.00 a year. Ill. Helpful to amateur gardeners, teachers and pupils.

General Science Quarterly. Salem, Mass. Quarterly. 40c a copy, $1.50 a year. The only journal published devoted alone to science in the elementary and secondary schools. It tells what schools are doing in science, gives lesson plans, demonstrations, and an extensive bibliography of usable articles in current periodicals.

The Geographical Review. Broadway at 156th St., N. Y. Quarterly. $1.25 a copy, $5.00 a year. Devoted to scientific geography. Original maps and pictures. One department contains condensed items of topics of current interest.

The Guide to Nature. Sound Beach, Conn. Monthly. 15c a copy, $1.50 a year. Ill. Of interest to elementary pupils and teachers of nature study.

Hygeia. 535 No. Dearborn St., Chicago. Monthly. 25c a copy, $3.00 a year. Popular articles on individual and community health. A valuable supplement to classroom work in hygiene.

Industrial and Engineering Chemistry. Box 505, Washington, D. C. Monthly. 75c a copy, $7.50 a year. A technical journal which contains much material which teachers can use.

Industrial Education Magazine. Peoria, Illinois. Monthly. $1.50 a year, 25c a copy. An illustrated magazine, which is indispensable to the shop instructor and to others who would "keep up" in industrial education.

Journal of Chemical Education. Easton, Pa. Monthly. $2.00 a year. Promotes chemical education; primarily a journal for the chemistry teacher. Digests of activities of chemical associations.

Journal of the Franklin Institute. Philadelphia, Pa. Monthly. 50c a copy, $6.00 a year. Ill. A technical journal. Contains many articles of value to science teachers.

Journal of Home Economics. 1121 Cathedral St., Baltimore. Monthly. 25c a copy, $2.50 a year. For teachers.

The Literary Digest. 354 Fourth Ave., N. Y. Weekly. 10c a copy, $4.00 a year. Has a department "Science and Invention." Articles are mostly digests from other journals. They are popular in nature and suitable for high school pupils.

National Geographic Magazine. Washington, D. C. Monthly. 50c a copy, $3.50 a year. Best monthly journal for high grade pictures. Articles are of interest to general reader, pupils and teachers, as well as to geographers.

The Nation's Health. 22 E. Ontario St., Chicago, Ill. Monthly. $3.00 a year, 25c a copy. An illustrated magazine devoted to community, industrial and institutional health problems. Very helpful to the science and hygiene teacher.

Nature Magazine. 1214 16th Street, Washington, D. C. Monthly, 25c a copy, $2.00 a year. A nature magazine, with popular articles exceptionally well illustrated. Includes what was formely "Nature Study Review."

Popular Mechanics Magazine. Chicago. Monthly. 25c a copy, $3.00 a year. Short science items and articles well illustrated. Appeals strongly to elementary pupils. Suggests many construction projects.

Popular Science Monthly. 255 W. 39th St., N. Y. C. Monthly. $2.50 a year, 25c a copy. A review in text and pictures of the news of science and invention, presented in a humanistic and inspirational way. Used as a supplement to text-books in many high schools. Valuable to science pupils and teachers.

Monthly Guide for Science Teachers. Issued by "Popular Science Monthly," October to June. 25c a year. A valuable teacher's aid, giving lesson plans, experiments, and many reference suggestions for secondary science teachers.

Practical Electrics. New York City. Monthly. 20c a copy, $2.00 a year. This is especially suggestive to boys who are making things electrical. There are numerous articles on electrical topics.

Radio News. 53 Park Place, New York City. 25c a copy, $2.50 per year. Monthly. A practical periodical for all who are interested in radio. Gives radio progress, new hook-ups, and gives much help to one who may wish to construct his own set.

Review of Reviews. 30 Irving Place, New York City. Monthly. 35c a copy, $4.00 a year. An illustrated monthly covering world affairs. Contains many good articles bearing on science, suitable for class reports.

Safety Engineering. 80 Maiden Lane, New York. Monthly. $3.00 a year. 25c a copy. A journal devoted to conservation of life and property and contains much material helpful in science classes.

School Science and Mathematics. Chicago. Monthly. $2.50 a year. A teacher's journal. Includes many helpful suggestions.

Scientific American. Woolworth Building, N. Y. Monthly. 35c a copy, $4.00 a year. Has longer articles than the other popular science journals. Illustrated, and is particularly valuable to high school science pupils and teachers.

Science and Invention. 53 Park Place, N. Y. C. Monthly. 25c per copy, $2.50 a year. Ill. Popular articles on astronomy, physics, photography, radio-activity, medicine, and, in fact, science in general.

Scientific Monthly. Garrison, N. Y. 50c a copy, $5.00 a year. Articles as a rule are more along lines of pure science. Much of value to teachers. Articles can be read to advantage by many pupils.

Science News-Letter. Science Service, 1115 Connecticut Ave., Washington, D. C. Weekly. 10c a copy, $5.00 a year. Gives a valuable current summary of the progress of science, in a form usable in science classes.

Transactions of the Illuminating Engineering Society. 29 West 39th St., N. Y. Monthly. $1.00 a copy, $7.50 a year. Technical. Many articles contain material which can be used in high school classes.

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